SOUTH NATION VALLEY

CONSERVATION INTERIM REPORT 1948

RECOMMENDATIONS AND SUMMARY

DEPARTMENT OF PLANNING AND DEVELOPMENT

Department of Planning and Development

HON. WILLIAM GRIESINGER, Minister

A. H. RICHARDSON
Chief Conservation Engineer

South Nation Valley Interim Report

1948

RECOMMENDATIONS and SUMMARY

TORONTO
Printed and Published by Baptist Johnston, Printer to the King's Most Excellent Majesty
1950

South Nation Valley Conservation Authority

Established May 8, 1947

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VICE-CHAIRMAN: J. P. MEILLEUR, Casselman, Ont.

CHIEF OFFICER: A. H. RICHARDSON, 863 Bay Street, Toronto 5, Ont.

SECRETARY-TREASURER: ALEXANDER ROGER, Box 25, Billings Bridge, Ont.

CONSULTING ENGINEERS: KILBORN ENGINEERING CO., LTD., Toronto.

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This Summary of the South Nation Valley Interim Report is composed of five sections, namely: General (Location and Boundaries, Geology, Physiography and land Settlement), Soils and Land Use, Forestry, and Wildlife, all for the whole watershed; and Hydraulics for that section of the River above the Village of Chesterville.

The following large maps are included in the Interim Report and a limited number are available on request:

Source Areas—Reforestation Land and Existing Woodland

Four sections, each 22 x 34, scale one mile to the inch. Four colours.

Soils

Map 26 x 18, scale two miles to the inch. Seven colours.

Present Land Use

Map 26 x 18, scale two miles to the inch. Seven colours.

Recommended Land Use

Map 26 x 18, scale two miles to the inch. Seven colours.

Land Use Survey—Detailed Study, Sample Strips

Charts, black and white, 18 x 14. Scale four inches to one mile.
Sample Strip No. 1—Winchester and Finch Townships.
Sample Strip No. 2—Cumberland and Russell Townships.

SOUTH NATION VALLEY INTERIM REPORT 1948

RECOMMENDATIONS STATED OR IMPLIED IN THE FULL REPORT

Land Use

1. That farm woodlots be established as well as larger tracts of forests; that existing woodlots be managed in accordance with good forestry practices.
2. That Conservation farming, particularly the practices of contour cultivation, strip cropping, restricted rotations and grassed waterways, be carried out on all sloping, erodible land on the watershed.
3. That land subject to drought and erodible land which cannot be protected by special practices be maintained under sod, further that pasture on this land be improved and restricted in its use.
4. That whereas fertile soils on the clay plains may be artificially drained to increase agricultural production, drainage be restricted on all wet sandy areas and all existing bogs which might act as natural reservoirs for water and the practice of burning peat be discontinued.
5. That portions of the silt plains, where economically advisable, be drained in order to widen the range of crops that may be grown, specifically to include potatoes.
6. That experiments and demonstrations be carried out to promote the use of Reed Canary Grass (Phalaris arundinacea) or other appropriate, productive grass cover on wet lands not suitable for drainage.
7. That investigations be made to find the correct mixtures and management to conserve poor soils by maintaining sod suitable for hay and pasture.
8. That some enquiry be made as to the feasibility of including the cultivation of cranberries in a program of water conservation in bog areas.
9. That the Conservation Authority maintain good contact with all existing agricultural agencies to promote a vigorous program of soil and water conservation.
10. That improvements and re-establishment of maintenance of existing drains be carried out only when it is necessary to rehabilitate areas already used agriculturally or when drains through bogs are outlets for drainage systems on the clay soils.
11. That research be carried forward into the management and handling of peat as a soil amendment on the soils near peat deposits.
12. That research be initiated on the value of bog area for stabilizing the water relations of river systems.

Forestry

1. That the South Nation Forest of about 198,076 acres, comprising 26 areas of marginal and sub-marginal land, be established by the Authority to protect the natural water storage areas of the watershed and form the basis of a sound forestry policy for the watershed.
2. That a fire control system be established under the Authority which will regulate the burning of slash and peat on private land and that a fire protective system be set up to fight fire anywhere in the watershed.
3. That natural regeneration be encouraged wherever possible and that open areas be planted where necessary.
4. That special studies be made to determine the best methods of establishing forests on wet areas particularly on peat and those lands covered with willow scrub.
5. That reforestation of privately-owned land be encouraged in every way possible, particularly on blow sand, shallow soil over rock, glacial beaches and poorly drained land.
6. That counties and townships be encouraged to establish and extend the forests within their boundaries.
7. That schools within the watershed be encouraged to enter the Provincial School Forestry Competition.
8. That the Authority expropriate all tax delinquent land subject to the regulations of the Municipal Act.
9. That the Authority adopt some scheme for granting assistance to farmers willing to fence their woodlots, similar to that recently adopted by the County of Halton.

Water

1. That conservation reservoirs be built at Spencerville, Domville and Hyndman.
2. That the dams at Spencerville Mill and Chesterville be rebuilt.
3. That a diversion channel be built from the Spencerville Reservoir to the St. Lawrence River.
4. That the bed of the river above Chesterville be graded.

Wildlife

1. That a part of the pond created by the improved Spencerville mill dam be designated as a permanent wildlife sanctuary.
2. That farmers be encouraged to improve land for wildlife by the elimination of grazing of woodlots, by selective rather than clear cutting, by planting small groups of trees and field boundary hedges and by planting wildlife food patches.

3. That the streams of the watersheds be improved for muskrats by any means capable of inducing permanent summer flow.

4. That farmers be encouraged to fence the river from cattle where possible and to plant the stream banks with alders and willows to prevent bank erosion.

5. That the trapping season in the watershed should be shortened to about ten days to correspond with the spring breakup.

6. That consideration be given to the idea of decentralized control over the setting of trapping dates to overcome the effects of differences in climate in different seasons and regions.

7. That the season on muskrats be closed for one year.

8. That where the Authority acquires extensive Source Areas, the right to trap for several years in succession be leased to individual trappers, thus giving the trapper responsibility for keeping marshes in productive condition.

9. That consideration be given to the protection of predators of the meadow mouse near reforested areas, particularly those hawks and owls known to feed chiefly on the mice.

10. That plantations in low and densely grassed areas be protected from the meadow mouse by improved cultivation practices.

11. That research be encouraged in the causes of fluctuations in the population of meadow mice.

12. That trials be made of the efficiency of poisons, deterrents, virus controls and natural predators in controlling damage to plantations by mice and rabbits.

13. That pollution of streams from creameries and cheese factories be controlled by septic tanks, sand filters or field tile beds.

14. That the introduction of fish into the watershed be restricted to those parts of the river shown by the survey to be suitable for the species concerned.

15. That interested owners of streams listed as suitable for speckled trout should be encouraged to improve them by constructing and maintaining small trout ponds and by other methods.

16. That the introduction of the following fish species be considered in the planned permanent warm water impoundments: largemouth bass, bluegill, sunfish and black crappie.

17. That the fishing in such impoundments be managed on a sustained yield basis.

18. That a survey be urged of the winter food and cover requirements of the Hungarian partridge at the margin of its climatic range in the watershed.

PART I—GENERAL

1. LOCATION AND BOUNDARIES: The watershed of the South Nation River is an area of 1,511 square miles lying between the cities of Ottawa and Hawkesbury on the River Ottawa and Brockville on the River St. Lawrence. On the southeast and for a short distance on the southwest the South Nation Watershed is bounded by that of the St. Lawrence. On the north, it adjoins the watershed of the Ottawa and on the west the watershed of the Rideau, whose tributary, Kemptville Creek, rises within ten miles of the St. Lawrence, north of Brockville.

   The South Nation River rises near Algonquin, northwest of Brockville, and flows in a northeasterly direction, on the whole, until near Pendleton. The river here makes a wide sweep to the east, so that it is flowing in a northwesterly direction when it reaches the Ottawa.

   From southwest to northeast the watershed extends about 76 miles in a direct line and its greatest width from northwest to southeast is about thirty-five miles. From the source area of the main river to its mouth is a distance of about 69 miles in a direct line.

   The drainage area of the South Nation includes parts of seven counties, and twenty-three townships lie wholly or partly within its watershed. Six of these townships lie entirely within the watershed—Mountain, Winchester, Finch, Russell, Cambridge and South Plantagenet. There are no towns or cities in the watershed which includes, however, the incorporated villages of Winchester, Chesterville, Casselman, Finch and Maxville, the first three of which are places of some size. There are several other fair-sized villages in the watershed which have not become incorporated as separate municipalities.

2. GEOLOGY: The watershed of the South Nation is underlain by nearly horizontal beds of ancient sedimentary rocks, mostly limestone. The surface topography is a plain, consisting of various land forms resulting from glacial action. The landscape is little affected by the bedrock except in the generally flat relief, but the material of the bedrock exerts a strong influence on the soils of the region.

   The Canadian Shield is exposed in the arm of the shield called the Frontenac Axis and extending through the Rideau country to Brockville. The sandstones, shales and limestones of the bedrock of the South Nation watershed were deposited about 350 million years ago over the hard rocks of the shield. The shield resists earth movements so that these rocks have remained fairly level. There has, however, been some tilting and cracking, resulting in "faults". Along the line of a fault there is an abrupt change in the kind of rock and sometimes in relief. Much of the upper part of the watershed has the dolomites of the "Beekmantown" formation. There is often very little soil over the rock. Lower down the river a limestone similar to "Kingston Limestone" is exposed in many places. This predominant limestone has an important influence on the soils of the region.


W. HAWKESBURY
LOCHIEL
ALFRED
CALEDONIA
PLANTAGENET
N. PLANTAGENET
PRESCOTT
KENYON
GLENGARRY
S. PLANTAGENET
MAXVILLE
CLARENCE
BOURGET
ROXBOROUGH
MOOSE CREEK
CASSELMAN
RUSSELL
CUMBERLAND
CAMBRIDGE
LIMOGES
STORMONT
VARS
CRYSLER
BERWICK
NEWINGTON
CARLSBAD SPRINGS
RUSSELL
FINCH
GLOUCESTER
RUSSELL
CHESTERVILLE
METCALFE
OSGOODE
WINCHESTER
WILLIAMSBURG
DUNDAS
MOUNTAIN
SOUTH MOUNTAIN
MATILDA
S. GOWER
OXFORD
EDWARDSBURG
SPENCERVILLE
GRENVILLE
AUGUSTA
ELIZABETHTOWN
OTTAWA RIVER
ST. LAWRENCE RIVER
MUNICIPALITIES
SCALE : MILES
1 0 1 2 3 4 5

North of the village of Russell there is an area of red shale belonging to the Queenston formation. It is very evident, the material overlying the rock giving the district a unique soil. Material from sandstone and ancient crystalline rocks has been brought by the ice from outside the watershed. Soils built upon this material are found to be acidic, while those developed on limestone or dolomite material are neutral or alkaline.

The problem of drainage on the watershed is not made easier by the bedrock. The limstone is tough and little eroded. The formation is flat and there is sometimes slight relief which cuts off areas from the main stream with no apparent external drainage though some water may escape through the limestone.

The bedrock geology of the South Nation Watershed is important for its effect on the drainage of the region and on the development of the soils of the watershed. The river rises on the flanks of the Frontenac Axis and flows with slight grade over a limestone plain. Inadequacy of drainage, both surface and internal, is caused by the geological build of the country.

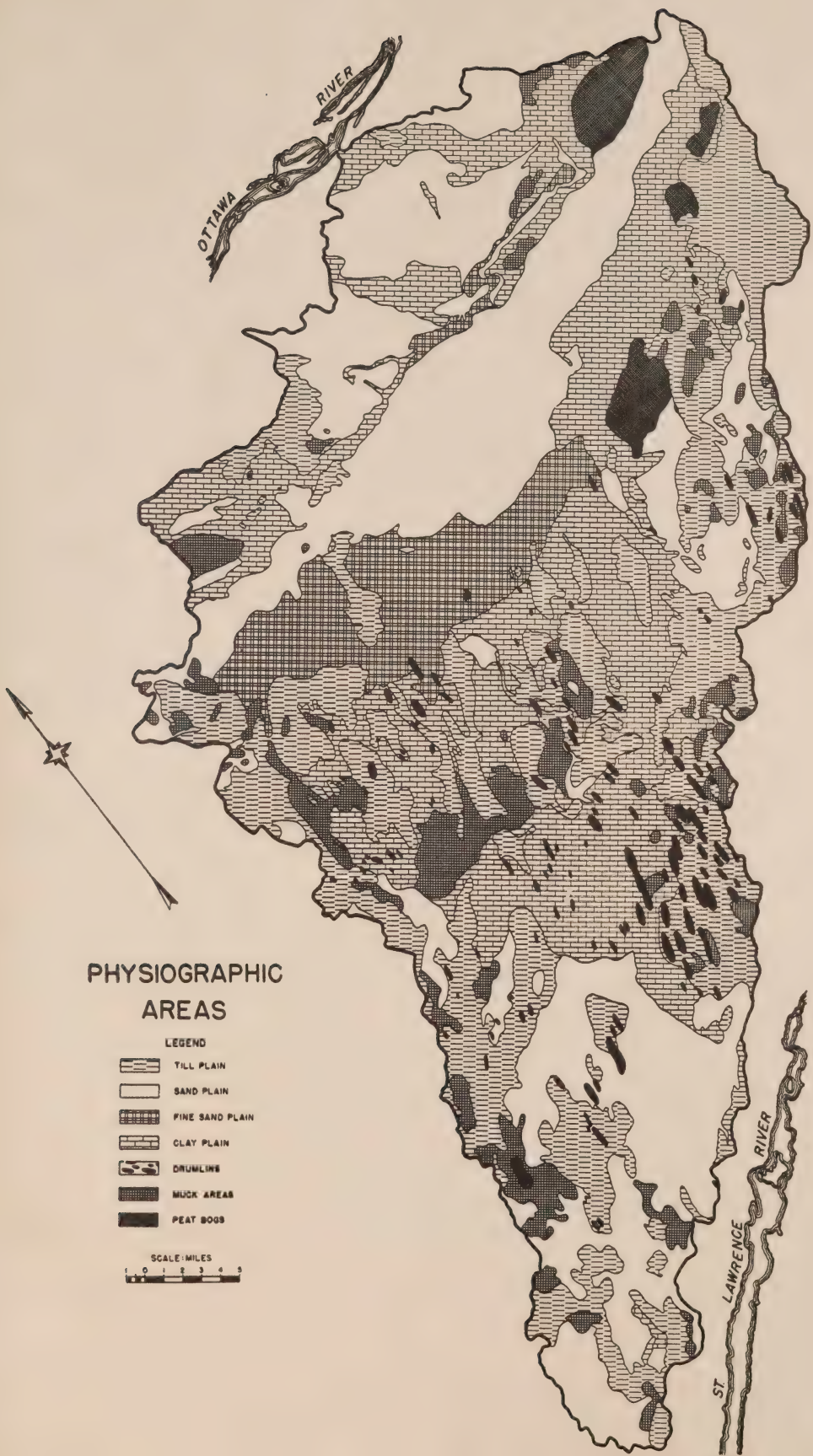
3. PHYSIOGRAPHY: The form of the mantle of soil over the bedrock of the watershed determines the land forms apparent to-day. Each land form described here is fairly uniform in material, gives rise to a family of soils and has a topography peculiar to it. Soil and topography have influenced the pattern of past land use and must be understood clearly if planning for the best future land use is to be undertaken.

As the continental glaciers melted they left rock material, scraped from the uplands or ground from the rock over which they passed, forming a "till plain". On the South Nation this till is a mixture of clay, silt and sand with many stones and boulders. Till is sometimes piled up in the form of oval hills called "drumlins". On this watershed the drumlins are not so high as is sometimes the case elsewhere.

Along the face of the stationary glacier melt water deposited areas of sands and gravel characterized by rougher relief. Shallow water also deposited sand in the form of a plain. Both these land forms are found near the headwaters of the South Nation River.

Much of the South Nation area was later covered by the "Champlain Sea". In the deeper parts of this sea and of fresh water lakes which followed it, great deposits of clay were made over the till in the form of a clay plain. Low drumlins appear in this plain, partly eroded and partly buried in clay. Beaches of heavy stones and boulders were left by the sea and lakes on slopes facing the clay plain.

As the glaciers withdrew, the Ottawa River began to flow down its old valley but emptied into the Champlain Sea. A delta was formed at its mouth which appears as a sand plain in Carleton, Russell and Prescott Counties. Later the river cut through this delta to form the present Ottawa Valley. The outer edge of the delta is of fine silt material; the inner edge is marked by a steep bluff where the river cut it away. The sands and silts overly the clay at depths of from a few inches to 80 or 100 feet.


OTTAWA RIVER
PHYSIOGRAPHIC AREAS
LEGEND
TILL PLAIN
SAND PLAIN
FINE SAND PLAIN
CLAY PLAIN
DRUMLINS
MUCK AREAS
PEAT BOGS
SCALE: MILES
1 0 1 2 3 4 5
ST. LAWRENCE RIVER

The South Nation is a very young river and flows across a flat plain. Headwater erosion can be seen in the formation of gulleys in the steep edge of the sand plain south of Bourget. However, undulations in the till plain, drumlins and rock outcrops still resist the stream action and many areas have not yet been tapped and remain undrained. The tributary streams which rise in uplands have cut a fairly effective drainage system across the till and some of the sand plains. The main branches, however, flow across the clay plain in shallow, meandering valleys. The main stream has cut a deep valley through the sand plain north of Casselman.

The Till Plain covers much of the upper part of the watershed, narrow areas along the southern and northwestern margins and large patches in the clay and sand plains. Its topography is gently rolling, rolling and hilly, with occasional slopes of 15 per cent, and elevations usually not over fifty feet above the valleys. The material of the till plain contains limestone from the underlying rock and the soil is influenced by this lime. Along the northwestern margin, the soil is lighter and mixed with gravel and sand.

Where the till plain has been smoothed off by water and is covered by deposits of clay, are found some of the best agricultural lands of the district. These stretches have most of the typical characteristics of the till plain and have been mapped as part of it since they do not show the most typical characteristic of the clay plain—poor drainage.

Most of the original limestone plain is covered more or less deeply by clay, sand or till which gives its present surface relief. However, there are some areas of shale deposits where the topography is still that of the rock plain.

The Old Beaches on the slopes facing the clay plain consist of long narrow strips strewn with large boulders. They have often been cleared of trees but are not suitable for tillage and are used only as pasture. They might well be wooded. They are not large enough for reforestation on a large scale but could be useful farm woodlots.

There are two Sand Plains on the watershed, one in the southwestern lobe and the other parallel to the Ottawa River. They are alike in material but differ a little in topography. The southwestern plains are undulating and when the slopes are not too steep and the soil adequately drained these sands form valuable agricultural soils.

The sands of the lower portion of the watershed are part of the delta referred to above. They tend to be too wet for agriculture. Slight variations in relief give marked differences in soil drainage so that soils too dry and too wet for crops may be found in the same small area.

The southern edge of the sand plain just described is a wide belt of Silt. These silts overly the clay and at the margin are thinly deposited. In some places patches of clay or till have been exposed by stream erosion. The area is flat and tends to be inadequately drained but in favourable positions the silty loams are quite productive under good management.

Large stretches of Clay Plain occupy much of the interior of the watershed

from the headwaters to the mouth. They have monotonous relief, broken occasionally by small hills of a different material jutting through the clay. The fertility of this plain is offset by the disadvantage of poorly drained soils. There are two main divisions of clay plain, the "neutral clays" found in Grenville, Dundas and the west part of Stormont Counties called the "Dundas Clay Plain" and the "acid clays" in Russell and Prescott Counties and in the lower part of the watershed in general.

The neutral clays consist of material washed from the limey till of the uplands and give soils nearly neutral in reaction. The heavy, close-structured clay combines with the flat topography to inhibit drainage, but being a waterlaid material it is stone free. The river system has not proved adequate to drain the land and wide flat stretches between the streams have no surface drainage at all. The clay plains had long been subject to floods before being cleared and it is hard to say how far clearing has aggravated the flooding.

The material of the acid clays was not so limey as that forming the neutral clays and it is often necessary to remedy this by liming the soil. The characteristic flat topography is not broken by hills as in the Dundas Clay plain. The acid clays are also badly drained but stone free and can be improved by ditching and tiling.

Drumlins are long, low, oval hills with gentle slopes on the sides and a steep slope at one end. They consist of material that is similar to that of the till plain. They are very significant in the distribution of land use and settlement in this region. Most of them are found in the "Dundas Clay Plain". They are better drained than the land surrounding them.

Peat bogs have formed in quite deep depressions in the undulating till plain and in shallow depressions in clay and sand plains. The size of the depression limits the first, but the second have a tendency to grow out over the plain.

The watershed includes parts of two of the largest peat bogs in eastern Ontario, the Mer Bleu and the Alfred, and the whole of two large bogs, the Winchester and the Moose Creek. There are many smaller ones.

The bogs start in depressions without surface outlet. Vegetation does not decay and the undecomposed residue which remains on the surface becomes consolidated into peat. One of the commonest components of peat is sphagnum moss. In a shallow depression the peat eventually fills the hollow and begins to grow outwards over the plain.

As the margin of surface of the peat becomes drier it begins to decompose and forms Muck. In many smaller bogs this has taken place naturally and there is only a few feet of muck over the clay, sand or till. Where the large bogs have been cleared and drained there are quite extensive areas of muck soils. Some peat has been reduced to muck by burning and some has been removed for commercial use. It can be assumed that there was more peat and muck in the early days of settlement than now.

PART II—LAND USE

1. GENERAL CONSIDERATIONS: A land use survey is an inventory of soil resources and present land use, an assessment of the adjustment of present use and an attempt to determine the best future use.

Four classes of present land use were mapped: forest, pasture, cultivated land and idle land (including slash).

Detailed studies were made of "sample strips" of the width of one farm and including some forty farms in a strip about ten miles long. Sample areas representative of well-drained drumlins and of water-logged soils of the muck and peat bogs were also studied in detail, since it was evident that drainage was a chief factor in land use in the South Nation.

The soils of this region belong to the two major groups known as "podzols" (developed under coniferous forest) and "gray-brown podzols" (under mixed hardwoods or hardwoods). Owing to the special conditions of poor drainage common on the South Nation the process of soil building is frequently incomplete and the soils can be classed as "immature". On the well-drained sands, however, fairly typical podzols have been formed.

The factors of climate and vegetation have had similar effects throughout the watershed, but differences of parent material and drainage have produced varied results. Soils formed from the same parent material are said to belong to the same "association". The association includes a number of "soil series", the result of different drainage conditions. Differences of texture within the series give rise to different "soil types". The soil series are given names, usually those of the places where the series was first observed.

Besides the actual soil types, slope, erosion, depth of soil, stoniness and surface drainage, all limit or determine land use. Four classes of sloping land were mapped according to their irregularity and to their degree of slope. Erosion was recorded in three classes, sand blows from wind erosion being mapped separately. Shallow soil and areas with many boulders were also recorded.

2. SOILS: Over most of the watershed the well-drained soils of the till plain belong to the Grenville Series, composed of material largely derived from the Beekmantown dolomite. There are some variations, notably the soil on till material derived from the red shale north of the village of Russell.

Because of good drainage, favourable location and ease of working, these soils have been used since the early settlement. The boulders which formed the only impediment to tillage were removed in early times. As these soils are often on slopes and have produced feed and silage crops for a long time, there has been some fertility depletion and erosion. This has rarely been severe, and has sometimes been avoided by good management. These soils carry the full range of crops common to the district.

The areas with this soil have been largely cleared and support general farming and dairying. A great deal of the feed for the large dairy herds of the district is grown on this soil especially on the drumlins surrounded by poorly drained clay soils.

Some soils lighter and sandier than the Grenville Loam were included with the well-drained till soils. There are also small, narrow strips of Kars Gravelly Sandy Loam, which tends to be excessively drained because of its coarse, open structure. Since this is warmer soil, favoured for early crops, it has suffered fertility depletion and erosion.

Four classes of inadequate drainage were recognized in the survey—imperfect drainage, poor drainge, muck soils and peat soils. The topography of the till plain results in many stretches of imperfect and poor drainage. Because this land has restricted ability to carry crops it has not been so thoroughly cleared of trees or boulders and is commonly in pasture when not under forest. It can be improved by ditching but the boulders usually prevent tiling.

Where drift is shallow over bedrock, soil building processes have been limited. These shallow soils have usually been cleared of the hardwood they once supported, but have proved of little use in agriculture and are generally used as pasture. This pasture usually dries up early in the summer so continued use merely aggravates the deficiencies.

This soil series on the limestone plain is called the Farmington. It is a light, dusty loam, relatively stone free but with some angular fragments of limestone. The depth of bedrock is usually under three feet. When not reforested it is best suited for pasture on large holdings with a limited number of stock per acre. White cedar has crept back in places where pastures have been abandoned.

The soils of the flat clay plains in Grenville, Dundas and Stormont Counties have developed on water-laid deposits of clay with a relatively high lime content. Though considered very fertile, their use is restricted because they have poor internal drainage and the land is too flat for good surface drainage. Water lies in the fields after thaws and heavy rain. Soils in these plains in the imperfect drainage and poor drainage classes are similar to the soil series called Carp and North Gower. Wherever the drainage is sufficiently improved and the land well worked, these soils have proved highly productive. Even without artificial drainage they have still a high enough capacity for carrying stock to make them valuable.

The acid clays (Bearbrook Series) of the other lobe of the clay plain in Russell and Prescott Counties, differ considerably from those just described. Since they do not contain the lime found in the clay of the Dundas plain, they have, in addition to inadequate drainage, the disadvantages of low lime content and acid reaction. They require liming and manuring as well as artificial drainage and careful working. Where sand or silt overlies the clay, these lands are more easy to work and with artificial drainage are highly productive.

Throughout these lower clay plains there are areas subject to flooding, which receive a welcome addition of fertility from deposited silt. Since these areas are close to the watercourses they are also more easily drained after the flood and the early spring floods are hardly more than an inconvenience. The later floods, however, can be disastrous and it is this flood hazard which restricts much of this land to hay and pasture.

There are three main areas of sand on the watershed—an undulating area mostly in Grenville County, a more level stretch mostly in Mountain Township and the large area that stretches across Russell and Prescott Counties. Four soil series are found in these sandy areas—the Bridgman, Uplands, Rubicon and Granby Series.

The Upland series is the dominant soil type in the areas of well-drained sand. It is an open, sandy soil, low in lime, developed under coniferous forest with a podzol profile. Where a high water table reduces the oxidation a heavier top-soil develops and under good management a richer soil is found. The well-drained sands include soils that are well adapted to specialized crops such as potatoes, hops, small fruits and vegetables, and others so weak that they support only trees or very thin pasture. These latter should be reforested.

A great part of the sandy area includes soils of the Rubicon Series. Where its drainage and profile development are fairly uniform this soil is generally productive and is considered a good soil. Many poorly drained depressions or excessively drained knolls sharply decrease its agricultural value. Farming with a wide variety of crops is carried on, and can be carried on in future on these soils without serious problems if good practices are used. Draining of any but the wettest areas aggravates the difficulty of maintaining organic content. Where the sand plains are so flat that water remains on the land until late in the season, little use can be made of soil otherwise resembling the Rubicon Series.

Soils of the Granby Series constitute one of the major land use problems on the watershed. The thick black topsoil is tempting and much land has been cleared and worked. About the only crop it carries successfully is buckwheat. Where it has been effectively drained it has proved productive of a wide range of farm crops, but without careful management it barely supports hay and pasture and often has reverted to willow scrub. It is doubtful whether areas of this soil are worth draining except for use in conjunction with other soils. Any sandy soil suffers from the disadvantage of a rapidly diminishing organic content, draining accelerates this defect and to do so at considerable cost seems hardly worthwhile.

Soils of the Castor Series occur in the belt of silt on the southern margin of the sand plain in Russell and Prescott Counties. The wetness of the soils tends to assist in retaining organic matter, but they suffer from low lime content and excess moisture. As found after clearing they have proved most useful in the production of hay and pasture but with improved drainage and good management are capable of carrying a wide range of crops. It has been suggested that these soils might be used for growing potatoes. This would be feasible on the edge of this area but poor drainage might restrict the use of the interior to forest.

All the areas of all the different kinds of soil are listed in a table from which the following significant extracts have been taken.

Land of all types classed as shallow.....	46,132 acres, about 5 per cent of the watershed.
Soils of the till plain; inadequately drained and not suitable for draining.....	57,000 acres, 6 per cent of the watershed.

Soils of the clay plains which might be improved by drainage..... 225,000 acres, 23 per cent of the watershed.

Poorly drained soils of the sand plains... 39,700 acres, 4 per cent of the watershed.

Sloping land on the till plain and on drumlins, susceptible to erosion ..... 40,000 acres, 4 per cent of the watershed.

3. PRESENT LAND USE: Conservation calls for an adjustment of land use which will ensure a good return from the soil without further loss of soil or water. Land that is unwisely used will finally cease to be worth working and in time people will be forced off it, but it is then often too late to do anything effective to restore it. It is the purpose of conservation to correct land use while there is yet time.

After land is first occupied adjustments of use are forced on the cultivators by economic or natural conditions. At any stage the pattern of present land use is an indication of the capabilities of the land and the future pattern is likely to resemble the present in some degree. It is for this reason that an inventory of present land use is made on a conservation survey.

In mapping nearly a million acres, a very simple classification is made of present use. The classes recognized in this survey were cultivated land, pasture land, woodlot and idle land. Estimates were made of the proportions of each class in the blocks of approximately 1,000 acres enclosed by concession and side roads. The "dominant" class was then entered on the map. In some cases no one class was dominant but two classes accounted for 60% or more of the block. This led to the recognition of two classes combining "pasture and cultivation" or "pasture and forest". Some other blocks had to be classed as "mixed land use" since no one or two classes accounted for more than 60%.

While 47.7% of the watershed is "predominantly" cultivated land, only the drumlins, the clay plain and silt plain have as much or more than the watershed average under cultivation. Only 40% of the till soils are predominantly cultivated but they do not carry much forest or idle land. The proportions of "pasture and cultivated" land (25%) and "mixed use" (24%) indicate the broken nature of the till plain.

The soils of the sand plain are not so intensively used as other soils and the pattern of land use is more complex. Muck and peat soils are less intensively used on the whole than any others, with limited areas of specialized use and high proportions of idle land (17% on the muck and 56% on peat).

Only 2.4% of the watershed (including the Larose forest) is covered by woodlots extending over more than 60 per cent of a block. Most of these are on muck or sand soils. Peat deposits are more than half idle.

Floods are the most spectacular feature of maladjusted land use in the South Nation. The early settlers allowed for the floods in placing their buildings and so long as their herds depended chiefly on hay and pasture the flooding was not a serious handicap. Modern conditions, however, call for

increased and year-round production of milk and a reliable supply of feed grain and corn silage. The flooding shortens the growing season and a late flood can be a disaster.

This makes the risk of floods a major problem, but the problem of poor natural drainage is of greater significance in the watershed as a whole. It is even more acute because many poorly drained soils such as the Carp and North Gower Series, have the greatest latent fertility. Increased production from these fertile soils is only possible with effective artificial drainage.

The well-drained soils constitute the other important group of intensively used soils. Since there is a demand for crops which can be more easily grown on this land, much that is subject to erosion, fertility depletion and excessive run-off is intensively worked. Shallow soils, better left under forest, are pastured and well-drained sandy soils are cultivated because they can be planted early. Under a protective covering of sod or forest these soils would hold back water; under intensive cultivation they contribute to the cause of floods and are subject to erosion and depletion.

At present the conditions which have restricted land use most severely are shallowness and wetness. Sloping and light soils are still quite intensively used. Both these kinds of land can be protected by permanent cover of sod or trees and by special conservation farming practices.

Very little muck or peat soil is under cultivation at present. Wet land formerly cultivated is now often covered only by willow scrub of doubtful use to the watershed.

Where wet lands, particularly the sands, have been made productive by special treatment, such as drainage, only the margins have continued in use. The interiors remain idle under willow scrub or worthless forest cover. Drainage of wet sands or muck and peat soils involves eventually a loss of fertility. Much of this land is considered suitable for reforestation.

4. LAND CLASSIFICATION: Conservation of soil and water involves control of excess run-off, maintenance of summer flow and preservation of fertile soils for agriculture and forest industry. The last objective is even more important than the first two. The lands of the watershed have been classified with regard to the uses which will favour a conservation program.

Two of the projects suggested for conservation of soil and water are reforestation and the retention of land in pasture. A good deal of land is restricted to hay and pasture by natural features. Where land is to be withdrawn from agriculture, the volume of production may be maintained in three ways: by artificial drainage of fertile land on the clay plains and part of the silt plains; by conservation farming on land subject to erosion; by the improvement of long term pastures by cultivation, fertilizing and seeding with grasses and legumes.

There has always been artificial drainage in the watershed. There are many award ditches and some municipal ditches, but most of these are in a lamentable condition of neglect. Scarcely any townships have by-laws to finance tile drainage and the small amount already installed is limited to

lands near permanent water courses and these are subject to floods. Under existing legislation, drainage surveys are the responsibility of the municipalities. The emphasis in the future should be on the drainage of areas which have proved their usefulness to agriculture rather than muck and bog areas which may be left for water storage.

Conservation farming applicable to the sloping lands on the South Nation involves three main practices, contour cultivation, strip cropping, restricted rotations; the use depending, in any one area, on the degree and regularity of slope prevailing. The usefulness of these practices has been amply proved by experiment. The first two have hardly been attempted in the watershed.

Grass is probably our most important crop, yet it is the most neglected. Even where there is excellent management of field crops, improvement of long term pasture is often possible. In this watershed two kinds of land are affected: well-drained soils on sloping and erodible land, and the inadequately drained soils which cannot be economically or conveniently drained. Experiments in Ontario and elsewhere have shown that Reed Canary grass is a very successful crop on land of this kind with careful management. Some demonstration plots of long term pasture with improved mixtures have been sown in the watershed. This practice can be extended to include rough, stony, shallow and sloping soils, fit only for pasture, which can be made far more productive. Where summer drought diminishes pasture yields, cattle must be grazed elsewhere to prevent over-grazing and consequent erosion.

In classifying land for recommended land use, seven classes have been used.

Unrestricted Farm Land can be used for the full range of crops with ordinary good farm practices and remain productive indefinitely.

Drainable Land has a high potential fertility and a wide range of crops with artificial drainage. Maintenance of drains is of the highest importance.

Conservation Farm Land requires special practices to prevent erosion and water loss. These can be used on slopes up to fifteen percent.

Conservation Pasture includes steeper slopes, irregular slopes, shallow and bouldery soils, which are best kept under permanent sod as far as possible. With fertilizer and improved grass mixture these slopes can produce good pasture. "Trash mulch cultivation" may be of use on these slopes to prevent erosion when re-seeding. Shallow soils require restriction in pasturing during droughts.

Reforestation on a large scale is discussed elsewhere, but small areas not included in the plantable land might support well-managed farm woodlots. Since these should not be pastured, any loss of pasture can be made up by improved pasture management on other parts of the farm.

Hay and Pasture has long been a feature of land use in the watershed. The value of this type of land should be recognized. Artificial drainage of some land of this type will increase the importance of the remainder.

Special uses are found in scattered groups rather than well-established belts. The increase of this type of crop is controlled by demand and accessible markets and there are ample areas of suitable soils available for any extension likely to take place in the watershed. The growing of cranberries on suitable bog land such as the Mer Bleu and Alfred bogs might prove highly profitable since good markets are at hand under modern conditions of transport.

The conditions determining the classification of certain types of soil are as follows:

Unrestricted:	Soils on the till plain, generally on less than 2 percent slopes. Sandy soils, of proved merit, of the Rubicon series.
Drainable:	The soils of the clay plains not covered by muck and peat, some of the soils of the silt plain.
Conservation-Farming:	Soils on the till plain with regular slopes under 15 percent. Land on the drumlins, nearly all sloping but rarely over 15 percent.
Conservation-Pasture:	Hummocky land, steep slopes and soils droughty because of sandiness or shallowness. Bouldery land, hard to work with mechanized equipment.
Reforestation:	Soils of extreme wetness, stoniness, shallowness, erosion and steepness of slopes. Small areas on abandoned beaches.
Hay and pasture:	Poorly drained land in which drainage is either not feasible or is considered prejudicial to other parts of the watershed.
Special Use:	Fragments of sand, silt and muck areas, favourably located for cash crops.

5. RECOMMENDATIONS AND REGIONAL PLANNING: Re-adjustments of land use are required to obtain the fullest use and set right certain conditions caused by past exploitations of the land. The suggestions contained in the report are a guide to future development which might take a generation to accomplish. The various agencies which will be concerned with carrying out a conservation program are discussed.

Unrestricted Farm Land is the responsibility of the individual farmer with the help of organized groups and government services. Good farming on this land is the first and most important step in conservation.

Conservation Farming under our way of life is also the responsibility of the individual, making voluntary use of the expert technical services made available to him by government. The Ontario Agricultural College has established a farm planning service and good literature on the subject is also available. Contouring and strip cropping should not be undertaken without the help of an experienced planner as a badly planned layout may do more harm than good.

Conservation Pasture can also be carried out by private operators. In some cases the present layout of farms raises difficulties which may be over-

come by renting or selling such land to the owners of large herds. Land acquired by municipalities for reforestation projects might also be made available under proper restrictions, at any rate for a time.

In the Reforestation of small areas as farm woodlots some way might be found to assist the farmer in planting since time and labour are not often available for this purpose.

The Special Use of land for cash crops is also the responsibility of the individual proprietor. It can be carried on anywhere on the watershed where conditions are favourable and is not likely to conflict with conservation measures. All special use depends for profit on marketing conditions and some types in the watershed have been directly affected by the Ottawa market. New developments on the St. Lawrence may provide new markets for special crops in the future.

Planning of future use is likely to conserve the resources of the land and to avoid the learning of its limitations the hard way—by loss and failure. The people living in a watershed are concerned with both the soil and water of the area. Though the burden of soil and water conservation falls chiefly on the individual owner it is only by the combined effort of all the people of a watershed that a conservation program may become effective.

6. DETAILED STUDIES OF SELECTED AREAS: The purpose of these detailed studies was to acquire a more thorough knowledge of representative areas than it is possible to obtain by a general survey of such a large watershed. Two sample strips were chosen in order to include all the major types of soil. Sample areas containing only one type of soil were also examined on the well-drained, loamy drumlins in Mountain and Winchester Townships and on three bog areas in different parts of the watershed.

These investigations were carried out with great care and in great detail. Differences in soil, slope and drainage were classified to a finer degree on the maps of the special areas than on the general map. The ten classes of land use recognized allow distinctions between permanent pasture, meadow land used for hay and pasture and hay cropped as part of a rotation. The actual amounts of grain and corn were also determined.

7. SAMPLE STRIP No. 1—CLAY, SAND AND TILL PLAINS IN WINCHESTER AND FINCH TOWNSHIPS: This strip was chosen to illustrate the land use on the neutral clays, the sands and the loamy tills of the watershed. Shallowness of soil, inadequate drainage and flooding and, to a less extent, erosion and over-cultivation are the limiting factors. The maintenance of fertility and soil water and the use of marginal and sub-marginal lands are the conservation problem of the area.

The kinds of farms on the areas were also recorded and may be considered typical of the watershed. Milk was considered the major product and farms were classed according to whether the milk was shipped to dairies (whole milk), condenseries, cheese factories or creameries. Income is also derived from sale of young stock, beef animals, hogs, sheep and special products.

Thirty-five percent of this strip is on the till plain or on drumlins. The whole watershed contains twenty-nine percent of these soils. The percentage of sand is the same as that of the watershed (33%), but the proportion of clay soils (32%) is somewhat larger.

The conditions of drainage on the strip are summarized as follows:

Class of Natural Internal Drainage

	Acreage	Percent of Soil on the Strip
Well drained	1,224	20.4
Imperfectly drained	1,629	27.1
Poorly drained	2,276	38.0
Bog soils	844	14.0
Bottom land	27	0.5

Each of the major groups contains inadequately drained soils, but the proportion of well-drained soils is larger on the till and of poorly drained on the clay.

Erosion is not a very serious problem, but some erosion was observed on 21 percent of the area and this condition can be aggravated by increased cropping for corn and grain instead of hay and pasture. Measures to control erosion help to conserve water in the soil. This can be of great help on well-drained soils in dry summers such as that of 1946.

Of the 6,000 acres studied, 525 acres have shallow soil, 231 acres are too stony for regular cultivation, and 37 acres are both stony and shallow. The shallow soils warm up early and are generally used for corn and grain in spite of the difficulties from summer drought. The stony soil is used for pasture, but would be better in woodlot, while the pasture lost could be compensated for by improving other pastures.

The largest land use class was permanent unimproved pasture (1,552 acres), hay and pasture occupied 987 acres, hay in rotation 927 acres, and grain 725 acres, while corn was only grown on 126 acres. The small amount of corn is due partly to lack of warm land and partly to a wet season in the year of the survey. As a result there were 783 acres of ploughed land, classed as summer fallow, much of which had been prepared for crops but not sown owing to the late season.

The effects of floods and of poor drainage are not indicated by these figures. Four lots of the strip are subject to flood, while others are on poorly drained clays. Corn, grain and hay on these clays can only be grown on fields near ditches or watercourses, consequently farmers whose land lies wholly on the clays are forced to grow crops on soils not well suited to them. More attention is paid to artificial drainage on such farms than where well-drained land is available.

All the thirty-three farms on the sample strip ship milk. Seventeen sell to cheese factories, fourteen to condenseries, two to both and none to

dairies or creameries. The type of milk outlet appears to be a matter of personal choice and not related to the type of soil or to transportation.

The majority of the farmers sell young stock (22 out of 33). Only two sell beef animals. There is a close connection between cheese and hog production. Twelve of the farmers who ship to cheese factories raise hogs and only two of those who ship to condenseries. Since some of the feed for cows is imported from outside, much of the grain for hogs is presumably also imported.

Besides the sale of milk, young cattle and hogs are the principal source of income. Beef, sheep, poultry and specialized crops have only a small part in the economy of the region.

If land use were perfectly adjusted there would be no need for a conservation survey or program. There are three main reasons why land is used for crops not suited to it—economic pressure, rectangular layout and human inertia. Economic pressure, such as a need for silage corn, may make it necessary for a farmer to grow crops on poorly drained clay when no better drained soil is available. The rectangular layout often results in suitable and unsuitable land being found in the same field. The small areas of unsuitable land when taken together make a formidable total of poor adjustment, since it is seldom practical to plant a different crop on an acre or two. Inertia keeps people doing what they have always done, in spite of unsatisfactory results. It can, however, act as a stabilizer, preventing wasteful experiment. When a method has been proved useful it is only a matter of time till it is adopted. Contour cultivation on slopes and the adoption of new grass mixtures, with possibly the use of grasses and legumes for silage, might be adopted when their usefulness in the region is proved by means of test and demonstration plots.

By mapping and measuring the distribution of different crops on the various soils, it was determined which soils were preferred for each crop. While these measurements can not establish the absolute value of soils for crops, it is believed that the relative preference over many years which they indicate is the best guide to soil capabilities.

The results of these measurements are recorded in a series of tables. By means of this analysis it is possible to determine which soils are adaptable to the different phases of a general conservation program for the whole watershed.

This analysis is also of service in planning individual farms, which is the quickest way of adjusting land use to soil capability. In this watershed, consisting of flat and undulating land, the first step would be re-adjustment of fence lines, so that land suitable chiefly for meadow can be separated from well-drained land fit for corn and grain in rotations. The next would be the introduction of contour cultivation and strip cropping on slopes. New fences should be erected to separate permanent pasture and to protect woodlots from grazing.

8. SAMPLE STRIP No. 2—SAND, SILT AND CLAY PLAINS IN CUMBERLAND AND RUSSELL TOWNSHIPS: The first sample strip did not include soils developed on silt and on waterlaid acid clays, two of the major

classes of soil on the watershed. The second consists of over 30 percent of silt soils and about 20 percent of soils developed on the acid clays or on sand, silt and muck at shallow depths over the acid clays. Nearly 12 percent of the area has soils developed on loam of the till plain, less well supplied with lime than in other parts of the watershed.

Branches of the river system have produced more slopes which show accelerated erosion where cultivated. The better surface drainage and the large area of light textured soils result in a much smaller proportion of poorly drained soils.

That major land uses are remarkably similar in proportion in the two strips is indicated by the following figures:

Use	Percent in Sample 2	Percent in Sample 1
Idle land	8.7	5.5
Woodlot	7.1	7.9
Permanent unimproved pasture	26.2	25.8
Hay and pasture	21.3	16.4
Hay in rotation	20.1	15.5
Grain in rotation	11.3	12.2
Corn in rotation	3.3	2.1

The emphasis on hay and pasture in strip No. 2 is obvious. The first strip had much more land prepared for grain which had to be left fallow.

Because of the great variety of types and conditions found on sample strip No. 2, an analysis and classification of the soil capabilities is more difficult. The soils are classified roughly as follows:

1. Most productive but requiring surface drainage—the level silt soils.
2. Productive but requiring soil building crop rotations, and conservation practices on the slopes—the loamy till soils.
3. Productive but limited in use—the level, imperfectly drained sands.
4. Productive when drained, limed and fertilized but not now intensively used—the acid clays.
5. Useful only for forest—the imperfectly drained, hummocky sands.

Imperfectly drained level silt covers the largest area of any single soil type. It is used a little less than average for pasture, a little more than average for hay and pasture, and considerably more for grain. Some artificial drainage is needed to enable it to carry a full range of crops. The imperfect drainage is due to a flat topography rather than to the character of the soil.

The sands which cover a large part of the area are generally described as inadequately drained, but appear in two aspects, level and hummocky. The level sand produces a soil of the Rubicon Series and is used chiefly for meadow and pasture, but also for grain and corn. The inadequate drainage is entirely due to flatness. The hummocky sand cannot be so closely identified with the Rubicon Series. It varies in characteristics and the degree of drainage can only be expressed as an average, excessively drained sand and bog occurring

close together. Of the 333 acres of this soil on the strip, 90 percent is either idle or in woodlot. The wisest use of this land is for forest.

Deposits of silt over sand, flat and imperfectly drained, cover 217 acres of the strip and are used almost as intensively as the silt soils.

Acid clays with inadequate drainage and muck over clay make up 2.7 and 4.2 per cent. Neither are intensively used.

Nearly 12 percent is covered by loamy soils of the till plain, often limited by inadequate drainage or slope. Of this 116 acres are well-drained and flat to undulating with slight evidence of erosion. Two thirds of this was hay, a quarter meadow or pasture, the rest in grain. Only one acre of this group of soils was in woodlot and none idle.

This strip has much more non-agricultural land than the Winchester Finch strip and is less intensively a milk producing region. There are no farms shipping to condenseries. Most ship to cheese factories but two shipped fluid milk to dairies. The boundary of the Ottawa milkshed crosses the area between the better loamy till and the poor sandy soils.

The typical farmer ships milk to the cheese factory, sells some stock and carries hogs. The absence of a need for winter production for condenseries explains in part the emphasis on hay and pasture. Generally speaking this area approaches "subsistence farming with dairying", while the Winchester area may be called a "commercial dairy region."

9. DETAILED STUDY OF WELL-DRAINED SOILS ON DRUMLINS: A study of the soils, crops and production of farms consistently situated on well-drained soils was made to find out how far they were self-sufficient in feed grain and their contribution to agricultural production.

The soil of the drumlins in the "Dundas" Clay Plain is similar to the Grenville Loam series. Boulders are a common feature, but have mostly been cleared from the surface long since and piled on the fence rows. Shallow gravel pits are found on the western slopes. Slopes up to six percent are common. Seepage lines, where the slopes of drumlins meet the heavier clay, produce narrow belts of poorly drained land around their bases. The details of soil types, slope, erosion and layout of buildings were carefully recorded on maps. Five drumlins totalling 819 acres were examined in detail.

Cropping is more intensive and woodlot and forest less common than is usually the case on steeper and stonier drumlins elsewhere in Ontario. These drumlins have been modified in structure by the sea which once covered them, and the lack of well-drained land in the region gives them a unique value.

A comparison of land use with sample strip No. 1 is made in the following table:

PERCENT LAND USE

	Fallow	Idle	Forest	Pasture	Meadow	Specialty
Drumlins.....	2.7	4.0	0.7	1.7	12.3	5.1
Sample area (Strip No. 1)...	13.0	7.9	2.9	25.8	16.4	.0

	In Rotation			
	Hay	Grain	Corn	Pasture
Drumlins.....	19.3	21.2	19.6	13.4
Sample area (Strip No. 1).	15.5	12.2	2.1	1.6

The proportion of summer fallow on drumlins is much nearer the average usual under the system of farming used. "Idle land" includes gravel pits, fences and land occupied by buildings, etc. Land actually in waste is extremely rare. Unimproved pasture is usually supplemented by pasture on flat land, since most farms on drumlins also include flat areas.

The first settlement of the interior of Dundas County was made on the drumlins and there is still a concentration of farmsteads on them. The axes of the drumline run at an angle of 45 degrees to the survey lines and a drumlin of 200 acres may be shared by four or five farms. The concentration of buildings prevents the use of a fair proportion of desirable land, but this slight disadvantage is compensated for by the great advantage in mixed farming of having two kinds of land on one farm.

In spite of the intensity of cultivation there is little serious erosion, since the use of stone fences makes for small fields and these are usually near the barn and have been regularly manured in consequence. Conservation farm practices, such as contour cultivation and the use of green manure as well as stable manure, are of value nevertheless to retain moisture needed in dry seasons and prevent artificial fertilizer from being washed off the land to benefit fields in the flood areas. The few operators on the drumlins who use artificial fertilizers report good results.

The numerous stone fences are a serious obstacle, since bull-dozers would be required to dispose of them. Mechanized equipment could be used more efficiently on the replanned fields and there would be less waste in fence rows.

The crops are grown primarily for milk production. Milk tests at local cheese factories show that herds on the drumlins have an appreciably higher butter fat test than those on the clay plain.

Corn for silage is the most important single crop. Cement silos are preferred, rather than the wooden ones common on the plains, which cannot withstand high winds on the more exposed drumlins. The Dominion Department of Agriculture recommends mixing alfalfa with corn for silage to correct a lack of proteins. For some reason, not yet explained, alfalfa tends to winter-kill on the drumlins. Oats are grown on the clay near the drumlins but in the wet year of the survey operators were forced to grow them on the slopes. Barley is next in importance. Its use for feed could be increased. A high proportion of buckwheat was grown because of the wet season.

Grasses make up the largest crop area. Meadow and hay in rotation cover 32 percent of the drumlins and there are also, on drumlin farms, large areas of pasture and meadow on adjacent flats.

Because the soil of the drumlins is more favourable to corn and grain, these farms can produce most of the winter feeds and fodder needed, but there is not enough well-drained land to have much effect on the problem of winter feed for the watershed as a whole.

The well-drained land on the drumlins is classed as "conservation farm land", since the intensity of cropping creates a danger of erosion and soil depletion, at least in a number of cases. The Authority might arrange for at least one farm on the drumlins to be planned along conservation lines.

10. LAND USE ON BOGS AND MUCK AREAS: Detailed investigations were made of the more significant bogs in the watershed to acquire knowledge of their extent and nature and to determine the present agricultural use and history in order to appraise their possible future use.

The muck formed around the edge of bog areas is of more value for agriculture than the peat. The boundary of the areas was taken as the line dividing muck from soil containing a large share of mineral matter. The areas were once larger, but where the organic content is low enough for the soil to be no longer muck, it was considered to be outside the muck area.

There are considerable differences between bogs in areas of sand and those in areas of clay. Those in sandy areas may be drier in April than in June. The level of the water table fluctuates and the muck is always too wet or too dry. Drainage of bogs on sand tends, eventually, to destroy the advantages of the muck soil and large areas of willow scrub on abandoned land of this type are evidence of its poor value.

The small bogs in the undulating land on the upper part of the river system are not intensively used and may form reservoirs to feed the river. They should not be further developed for agriculture.

Three quite large bog areas, entirely within the watershed, were examined in detail—the Centre Augusta, Winchester and Moose Creek Bogs.

Such of the bogs as were originally covered with forest were cut or burned over in early times. There is little or no timber of value on them to-day, and the land often reverted to waste after the wood was removed.

Artificial drainage of bog areas has been only partly successful. Lack of maintenance has rendered some drains ineffective and in many cases the "improved land" is only found on the margins and often is going back to scrub.

Parts of the bogs have been cleared for agricultural use, the peat, and even the muck, burned off where feasible and the land sometimes drained artificially. The land was then allowed to go under grass for pasture. The Winchester Bog (once partly under cranberries) is in this stage of development and on the Moose Creek Bog, land under pasture or scrub is being opened up for cultivation. The Centre Augusta Bog was the only significant case of specialized use of muck soils for vegetable growing. This industry depended on high prices in the Ottawa Market between the two world wars and the area is now going back to dairy farming.

The Alfred Bog has deeper deposits of peat and attempts have been made to exploit this resource. There was, for a time, an intensive agriculture on the margin of the bog, where sufficient organic matter had been left in reclaiming the land to form a fertile soil. Loss of minerals by leaching and of humus by oxidation, has left this "bread basket of Prescott" nearly useless and a problem area. Recent experiments in intelligent use of muck soil have been destroyed in some cases by the spread of fires set to burn off muck or peat on neighbouring properties.

In present land use, agricultural land is only on the outer margins of the bog areas and much of the artificial drainage runs through land not used for farming. The table shows the extent to which the three bogs are used:

Area	Cultivated and Pastured		Slash		Woodland	
	Acres	Percent	Acres	Percent	Acres	Percent
Centre Augusta....	795	27.7	1,057	37.0	1,010	35.3
Winchester.....	4,895	42.1	6,590	57.0	105	.9
Moose Creek.....	4,409	44.0	5,443	54.3	179	1.7

The Moose Creek area is the only one being reclaimed at present and has the highest proportion of agricultural land. The Winchester Bog contained a large cranberry area, and was probably never heavily wooded. Houses and barns are generally outside or on the edge of the muck area. The difficulty of moving waggons and implements across soft land limits the amount of muck land worked. The best results are probably obtained where there are both muck and well-drained soils in the same holding.

The more important conservation use of bogs is for retaining water throughout the season and releasing it gradually to augment summer flow. The bogs near the head waters appear to be functioning fairly well in this respect, but it is difficult to determine how far those on flat ground contribute to the stream flow.

Another use is for holding ground water to help in growing special crops that need water throughout the growing season. Peat has a large capacity for holding water by capillary action. Experiments to determine the value of peat bogs in retaining water might be carried out. In developing muck and peat areas for vegetables by drainage, there is danger of lowering the water table below the depth at which it is available to the plants by capillary action and also of gradually destroying the humus in the soil. Mechanical control of the water table at optimum depth for specific crops is the most efficient way of using such soils.

There are three main possible uses of bog areas in connection with agriculture. First, to supply peat in some form as a soil amendment on land deficient in humus. There are difficulties in doing this at present which may be overcome by research. Second, for the production of vegetables. This depends on drainage, available labour, and on market conditions, which are unfavourable at present, but may improve in the future. The third use is for general dairy production similar to that carried on on neighbouring

soils. It is very doubtful whether it is worth while to reclaim bog areas for this purpose. The tendency to "make new land" when more production is wanted is an example of "human inertia" and prevents experiment in pasture and soil improvement. The increased production can be procured by improved management of lands already in use, better than by futile and wasteful attempts to reclaim unsuitable areas.

PART III—FORESTRY

1. THE FOREST: Settlement in the South Nation Watershed was delayed by the rocky and swampy terrain and to some extent by government policy. Except near the southeastern headwaters, there were few settlers in the area until after 1800 and many areas were still undeveloped in 1829. The region was forest, broken only by some areas of bog, and the lumbermen entered the area in most cases before the settlers. The forest included stands of large pines, tall enough for ships' masts 125 feet long. The abundant white oak also found a ready market at Quebec. Large quantities of elm and ash were sold somewhat later, but beech and maple were considered useless and were burned and the ashes sold for potash.

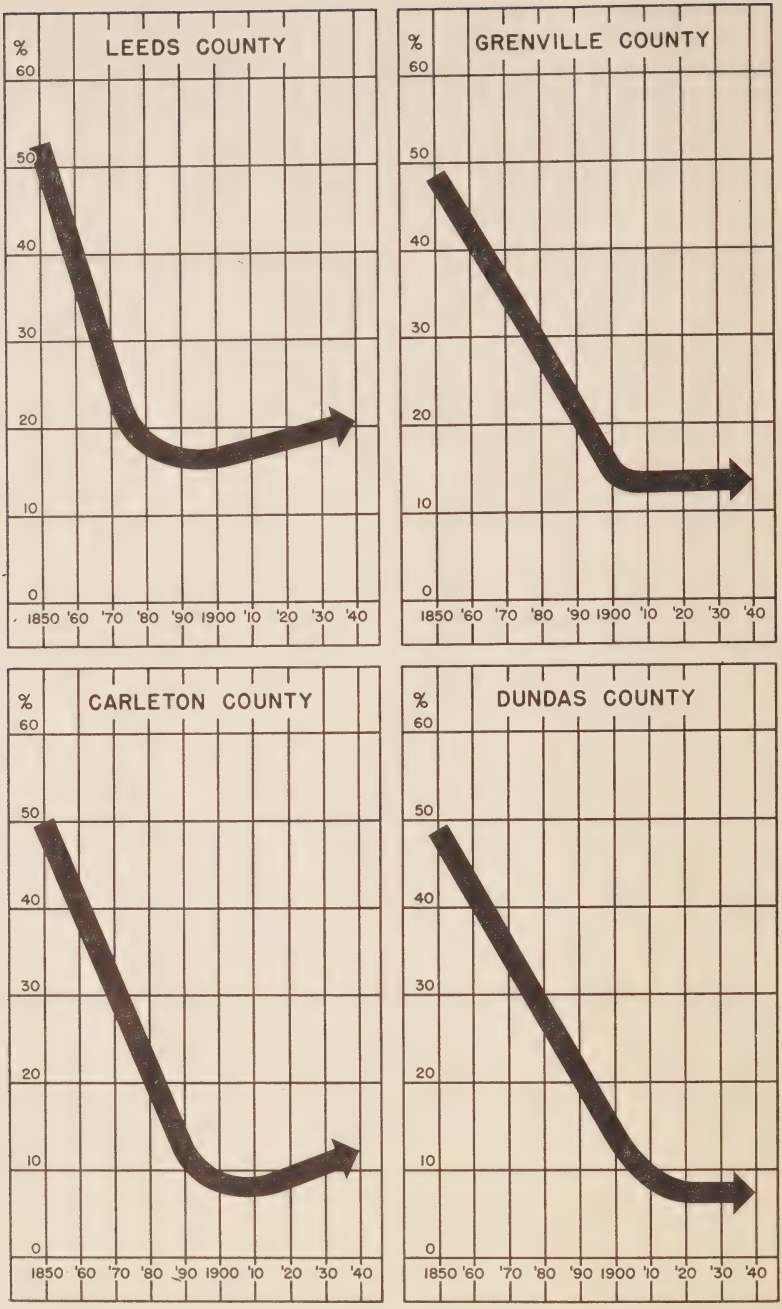
In the lower part of the watershed extensive lumbering began soon after 1806, when the first raft was taken down the Ottawa. The freshets on the main river and on the tributaries were a boon to lumbermen, as they enabled them to float their logs down quite small streams to the Ottawa. When the freshets failed to take place, it was reported in the Ottawa papers of the fifties as a serious misfortune.

Settlement and lumbering developed simultaneously. The well-drained lands which grew the best timber and were easy to work, were cleared first. Other areas, such as the sand lands in Russell County and swamp forest land in or near the bog areas, were never cultivated. The timber was cut and repeated fires prevented new growth. On the whole the extensive lumbering favoured the spread of settlement, but retarded its full development. From the 1820's well into the fifties there were complaints that the farmers in this region devoted too much of their time to lumbering and neglected their farms.

Early descriptions and the remnants of the woods which remain, indicate that the south-west corner of the watershed, the till plains on the southern boundary and the rock outcrops and drumlins throughout the area were covered with a mixed bush; sugar maple and beech being the dominant species associated with white and red pine, hemlock, balsam, basswood, red oak and white birch. The sand plains in Grenville and Dundas, and in Carleton, Prescott and Russell Counties, grew some of the finest white pine in the Ottawa Valley and early accounts speak of "the rich growth of pine" in Plantagenet Township.

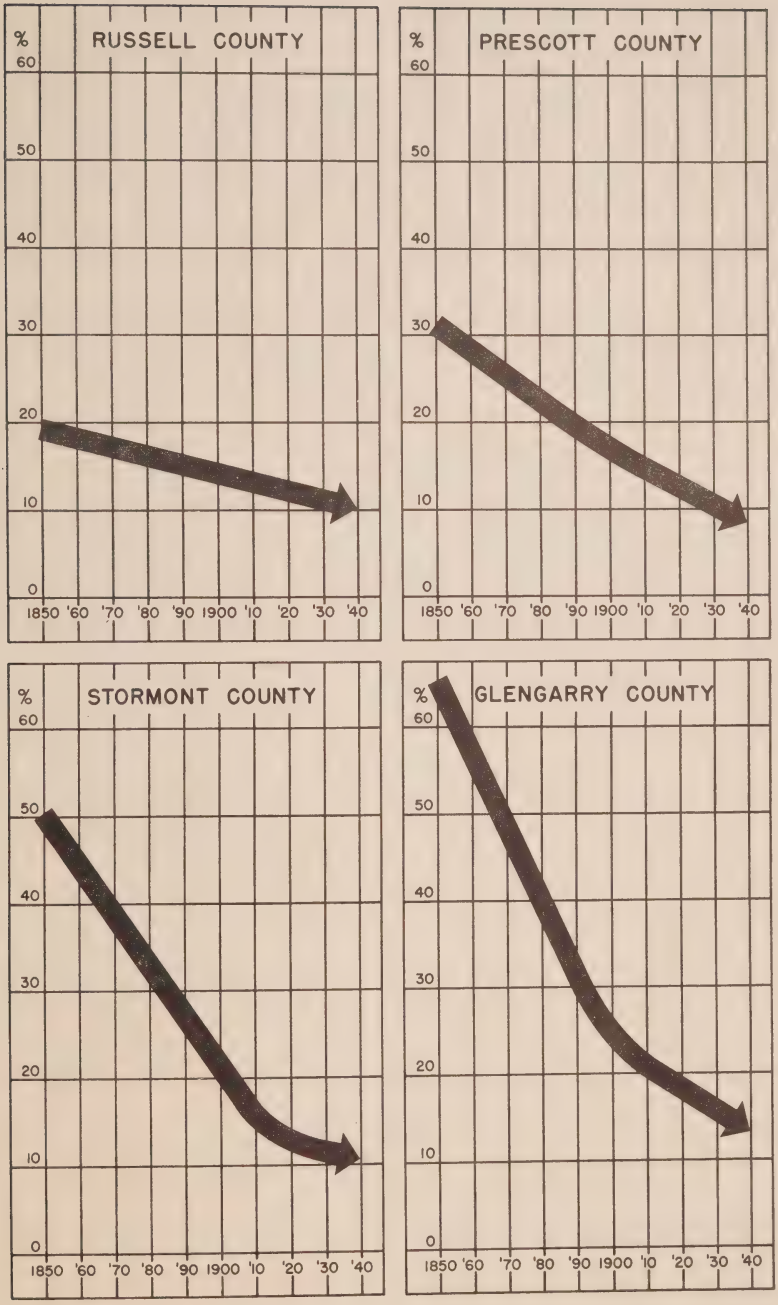
White pine was also found throughout the area wherever the soil was favourable and white cedar and white spruce throve on wet areas in the till plains.

The rest of the watershed was mostly swamp land covered with white elm, soft maple and ash and including a number of large bogs. These bogs



PER CENT WOODLAND

CENSUS OF CANADA FIGURES



PER CENT WOODLAND

CENSUS OF CANADA FIGURES

had no tree cover in the centres, but on the margins had dense stands of black spruce and tamarack with some gray birch and red maple. There were also large cranberry bogs, three of them in Dundas County, including the Winchester bog which covered 800 acres. These cranberry bogs were burned over, intentionally or by accident, every few years; a new crop of bushes springing up at once. In the lower part of the watershed, there were even more extensive bogs and swamps. The bog in Caledonia and Alfred (Alfred Bog) contained 5,000 acres, covered with moss to a great depth. The bogs in Roxborough and Cambridge Townships (Moose Creek Bog) and in Gloucester and Cumberland Townships (Mer Bleu Bog) were even more extensive than now.

These swamps and bogs defeated several early schemes for settling the area. Settlement was long limited to the higher ground and clearing the low ground for farming was going on in parts of some townships late in the nineteenth century.

The first task of the settlers was to clear the trees off their holdings. The fact that trees interfered with all their activities and the idea that the supply of timber was endless, led to an unfriendly attitude to the forest, which lasted until recent times. That the rate of cutting was very rapid, even after 1850, is indicated by the decline in the percentage of woodland shown in the Census of Canada figures. The counties near the Ottawa were depleted first. Russell and Prescott had about 20 and 32 per cent of woodland in 1850, while the counties along the St. Lawrence still had about 50 per cent. By 1940 all counties showed between seven and fourteen per cent wooded, with a slight upward trend in Carleton and Grenville, due to the abandonment of certain pastures.

There have been repeated fires in the area, references to them beginning with the early days of settlement. Later many fires were started by farmers to burn peat off the clay, and spread to the surrounding bush, destroying both timber and trees and new growth and reducing thousands of acres of sand and bog to virtual deserts. The greatest fire swept across the Russell sand plains in October 1897 and wiped out the town of Casselman.

The above figures show the rate at which the land was cleared rather than the rate at which the timber was cut. Cutting was at first largely selective and the line between woodland and wooded pasture was uncertain. Actual measurements of woodland area within the South Nation Watershed in 1946 and 1947, show a total of 150,675 acres or 15.6 per cent of the total area.

2. FOREST PRODUCTS: Until 1826 the timber on the public lands was reserved for the Royal Navy and could not be cut without license. There was a considerable illicit trade, but the restrictions were a source of annoyance to the people and authorities of the colony. A system was set up by which anyone was at liberty to cut timber on the ungranted crown lands of the Ottawa region by paying a fixed scale of fees.

Mast Timber was marked by government agents with a broad arrow blaze. As late as 1827 the Surveyor-General was ordered to make a survey of "Masting and other Timber fit for the use of His Majesty's Navy." The mast and spar export to Britain throve in the 30's and 40's and continued

intermittently up to 1855. The British trade dropped off noticeably after the Reciprocity Treaty with the United States in 1854, and after the building of railway connections with United States cities.

Squared Timber at first consisted mostly of white pine, squared on all four sides into one long stick. Later walnut, oak, ash, birch, elm, maple and even hemlock were made into squared timber. The timbers were built into huge rafts and floated down the Ottawa to the timber coves at Quebec.

In the very early days of settlement sawn lumber was prepared by hand-sawing in a saw-pit or with a platform on which the "top-sawyer" stood while his mate stood below the log. Twenty-five boards was a heavy day's work for two men. A few water driven sawmills were established before 1812 near the mouth and the headwaters of the river, but from 1818 the number steadily increased as the interior was opened up and by 1829 there were a number of sawmills on the main river and several on the tributary creeks.

A study of the Census of Canada forest products returns reveals the various changes in the lumber industry. From 1870 to 1890 squared timber was measured in cubic feet, logs merely counted and pulpwood, firewood, staves, lathwood, tanbark and masts and spars separately listed. The peak production was between 1880 and 1890 in nearly all items. Fence posts, telephone poles and railway ties were listed in 1890. In 1900 and 1910, staves, lathwood, masts and spars and tanbark are no longer listed. Squared timber is dropped in 1920 and logs are no longer separated by species. In 1940 only pulpwood (in negligible quantities) and firewood are listed separately.

Tamarack, listed in very large quantities, disappears after 1890 when the depredations of the larch saw-fly almost wiped it out. In 1880 there was considerable production of black walnut in all the counties except Carleton although this tree was not considered to be native here.

Wood was the sole source of fuel until 1850. With the introduction of steam power the forests of the area were ruthlessly cut to supply fuel for engines. Steamboats used fifty or sixty cords between Toronto and Montreal. For some time after 1856, the railways burned large quantities of the best body hardwood, chiefly beech and maple.

A great quantity of wood was consumed in building bridges and roads, both the early log "corduroy" roads and the later plank roads. Much cedar and some other wood was used for rail fencing, though pine stumps or stone sometimes took the place of rails. About 1900 wire fencing came into use and a fence-post industry developed.

Woodworking and planing mills were introduced into the watershed in a later stage of settlement. At first all the trim for buildings and the sash, doors and "blinds" (shutters) were made on the job by the carpenter, and even boards were planed by hand. Later water driven "planing and turning machines" were introduced and with the increased use of steam power, power planing and turning mills became more common and "sash, door and blind factories" were set up in some places.

Wooden implements and vehicles required special woods for the different types. Hickory was preferred for axle-helves, beech for the beams of ox-yokes and ironwood for the loop or "bow." Spike handles were made of rock elm, white ash, hickory or ironwood. Vehicles were first made by the farmers themselves, later by carriage and waggonmakers in the villages. A good deal of selected rock elm, white ash, hickory and ironwood was used for this purpose. Factories finally replaced the single craftsman or small shops in those types of woodworking.

The three most important indirect products were maple sugar, lye and tanbark. Maple sugar was almost the only sugar available to the pioneers, lye or potash was used in making soap at home, and tanbark in dressing leather by shoemakers and tanners. Maple syrup production dropped in all counties between 1890 and 1940 by 95 per cent.

3. PRESENT WOODLAND CONDITIONS: To get an accurate picture of woodland conditions in the watershed, a detailed study was made of all woodlands, natural water storage areas and plantable land. Every area of woodland, marsh, swamp or other wasteland, was visited and studied. Where doubt existed whether an area should be classified as woodland or not, woodland was given the benefit of the doubt.

All woodlots were grouped according to the Department of Lands and Forests classification in which the term hardwood is used for all broad-leaved trees. The type in which a stand is placed is that of at least 80 per cent of the trees. A stand in which neither hardwoods nor conifers predominate is classed as a mixed stand. Stands were also grouped according to the degree of maturity, cutting and forest cover type. Records were made of planting, care, damage and survival of all plantations.

There are 150,675 acres of woodland within the watershed or 15.6 per cent of the total area of 967,528 acres. Separate woodlots examined numbered 4,086. In many cases, differences in type and age made it necessary to list large single wooded areas as several woodlots, while other wooded areas, extending over several properties without boundary marks, were sufficiently uniform to be classed as one woodlot.

The chief conifers of the watershed are white pine, hemlock, white spruce, white cedar, balsam fir, black spruce and tamarack. White pine has been almost eliminated on the sandy soils; what remains is largely on heavier soils often associated with hardwoods. Hemlock is fairly common mixed with hardwoods and some white spruce remains, particularly in Kenyon Township. White cedar, balsam fir and black spruce are swamp types and are found on peat soils throughout the watershed, while white cedar also grows on limestone soils. Of the 150,675 acres of present woodland, 73 per cent is classed as pure hardwoods, 17 per cent as mixed woods and only 10 per cent as conifers. Of the 73 per cent which are hardwoods, 1 per cent is virgin timber, moderately culled, 38 per cent is second growth approaching commercial size and 34 per cent is young growth under four inches in diameter at breast height. In the mixed wood classes the 17 per cent is made up of 12 per cent second growth and 5 per cent young growth. The remaining 10 per cent which are conifers consists of 6 per cent second growth and 4 per cent young growth.

Soil profile development in well drained sand. The zone of accumulation is indicated in the picture. Note the lightness and thinness of the topsoil.

Poorly drained clay on the clay plain.

Imperfectly drained till soil

Headward erosion of a stream, causing the formation of a juvenile valley, has been accelerated by removal of forest cover.

An abandoned farm on shallow soil. Mulleins, dry pasture, bare rock and abandoned farm building often are found together.

Soil material on the clay plain. This is heavy, stone-free clay.

The open plains usually have enough wind to drive this windmill which is characteristic of the landscape. Large herds require some such means of supplying ample water.

A hop field near LaPointe bridge. The yearly acreage of this crop varies a great deal. It is found on the sandy and silty soils on the lower part of the watershed.

Truck gardening on a muck deposit.

Silage corn is an important part of the economy of a farm producing milk. Because of floods and cold, poorly drained land, this crop is often restricted to the lighter till soils.

Hay is one of the big crops. This has been grown on the silt plain in Russell County.

Holstein cows grazing on poorly drained clay land. This kind of land supports large herds.

Erosion on this seven per cent slope is evident in the silt collecting between the rows. This can be prevented.

How water erosion begins between the rows. This is on the sand ridge near Hallville. Contour cultivation, generous use of green or animal manure or restricted rotations help to prevent this.

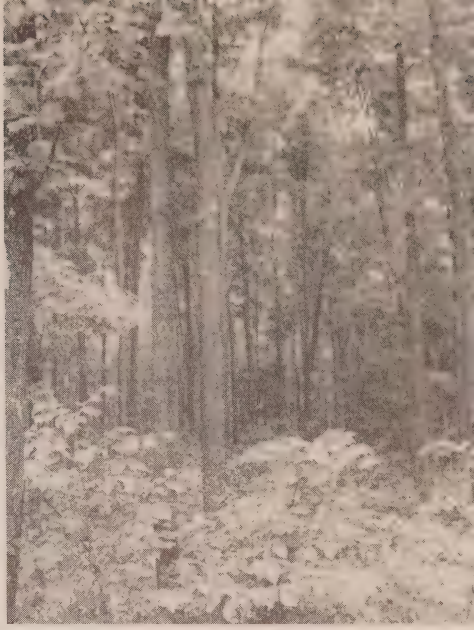
Blow sand in the upper reaches of the River. Protection by permanent vegetation will increase the water holding capacity of this material. In the meantime this sand is destroying the farm land on to which it blows.

An improved water course in Winchester Township. The improvement of existing watercourses is necessary to drain the land and to supply adequate outlet for ditches and tile drains.

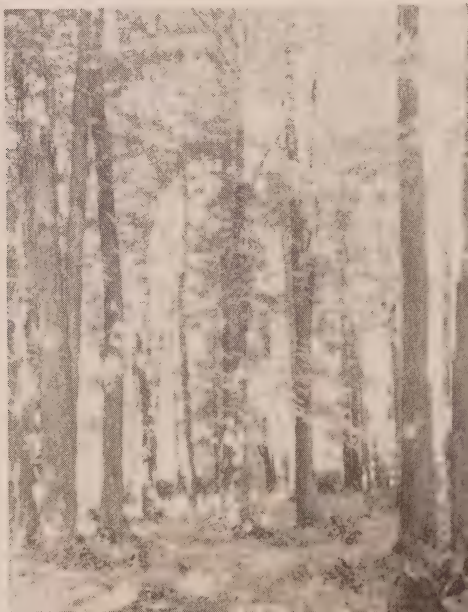
Scrub trees have blocked this drainage ditch. This is common throughout the watershed. Neglect of such a ditch just means "money down the drain."

The lack of good surface drainage on this field has apparently not been helped by this ditch. It is common to see as much as twenty per cent of a field left unproductive under standing water, yet the operator put as much seed and as much labour in preparing that part of the field as he did in the rest of it.

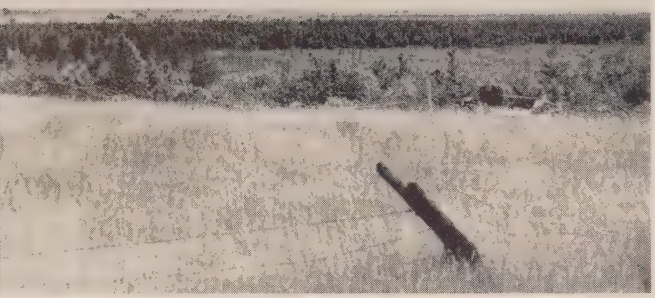
Type 14—Sugar Maple. Sugar maple grows well on the soils of the till plain even where the soil is very shallow. It reproduces itself well if cattle are excluded and should be used extensively for natural and artificial reforestation of the shallow soil area.



Type 4.—Aspen. This is a pioneer type following fire. In the South Nation Watershed it covers 45,000 acres and is to be found on much of the peat as well as the poorly drained sand land.



Type 60—Silver Maple-White Elm. This was the common swamp type of the larger part of the South Nation Watershed, covering thousands of acres on the clay plains. Where it was impossible to drain the soil the type still remains as the most extensive one in the watershed, covering over 55,000 acres.

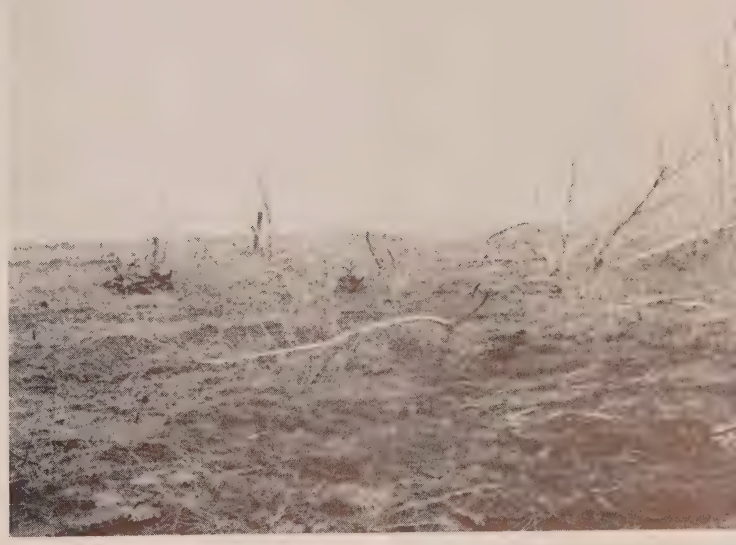


The Mer Bleue is a natural bog and marsh area which is too wet to support tree growth. It is one of the best natural water storage areas in the watershed.

Plantagenet Waterworks. A natural water storage area may be below ground as well as above ground and where it comes to the surface in the form of springs the rough slopes surrounding them should be wooded. Note the artificial reforestation in the background.

The Alfred Bog is likewise a great natural water storage area due to the depth of peat. Drainage has made much more of it able to support tree growth than would bear trees formerly.

Natural coniferous forest of the bog areas of the watershed has been almost completely destroyed by fire and peat soil in which the trees grow, has been burned so often that nothing but scrub willow and stunted poplar remain on most of these areas.



Fire set to burn peat on an adjacent farm spread under the road and burned the area where poplar was struggling to re-establish woodland cover.

The road in this picture was built on a two-foot layer of peat over clay. Fire set to burn the peat from a nearby farm spread to the road and burned the peat under it, rendering the road impassable

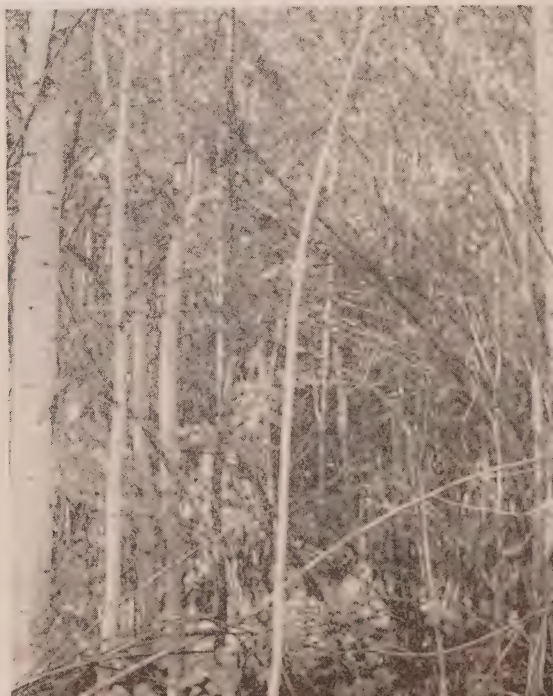
The practice of selling farm woodlots in acre lots leads to their total destruction, the operator stripping the area of trees. Usually cattle are admitted and the cover is soon reduced to willow scrub.

On light sand where the soil has lost its humus, wind erosion is severe and farms like this are being abandoned. Such areas should be reforested with pine.

Gully erosion is not a serious problem in many places but several gullies requiring control are found where streams drain from the delate sand to the lower level of the clay plain. This gully is near the school at Bradley Creek.

Here is a neglected pasture field covered with willow scrub.

After a number of years the willow scrub has reached its maximum height of 10 to 12 feet, a few aspens have managed to secure a footing and are breaking through the willow scrub cover.



Ten years later the aspen has completely closed the canopy over the willow scrub and killed it all by excluding the sunlight. A few white elm and silver maple are associated with the aspen.

Woodland in the last stages of destruction. Note the dead branches (stag headed tops) of the trees caused by overgrazing, tramping of the soil and invasion of the area by grasses.

A sugar maple stand in which all natural reproduction has been browsed off by cattle.

A white pine stand in which many of the trees are dying and sickly due to destruction of the natural carpet of needles by cattle.

Spencerville Damsite.

Spencerville Mill Damsite.

River bed at Spencerville, August, 1946.

River bed at Ventnor, August, 1946.

Flood waters at Salter's Bridge, Spring, 1938.

Salter's Bridge in Autumn.

Looking downstream on Black Creek towards the South Nation River.

Cass Bridge, King's Highway No. 31.

The Nation River polluted by cattle two miles above Spencerville.

Dredged streams such as this provide no muskrat territory.

The River above Crysler, showing scattered drying pools, fair muskrat territory

Bear Brook provides many miles of excellent habitat such as this.

The Payne River, fed by cool springs, is permanent and attractive.

The river at Ventnor is sluggish and full of vegetation.

Well shaded cool streams can be much improved for trout by small inexpensive dams of this type.

For the whole area the percentage of uneven-aged stands is 52 per cent. In Alfred, Caledonia, Cambridge and Winchester the percentage of even-aged stands is the higher, owing to the large bog areas which have often been burned over.

Grazing in woodlots is as high as 80 per cent for the entire area, showing how little value the landowners place on the woodlots as permanent crops. The number of cattle and the size of woodlot have a direct relationship to the damage done. A few head of cattle do not affect a large woodlot so seriously as a small one, but most farm woodlots are small and seriously damaged by large herds. Grazing destroys young growth and prevents re-seeding by interfering with the maintenance of the "forest floor" and this in turn affects the health of the old trees.

Next to grazing, Fire is the most serious menace on sandy lands and particularly on peat and muck soils. Here, crown fires, surface fires and ground fires all take their annual toll. Crown fires are the most spectacular and destructive and no attempt has been made to maintain the wide fire guards, without which they cannot be controlled. Surface fires are far more destructive than at first appears, because the heat from burning grass, weeds and litter on the forest floor can kill the trees without burning them. Ground fires are the hardest to handle for they burn in the peat for months even under snow and may break out again seriously in spring. These fires are often set deliberately to burn off peat and nearly always spread to adjacent land. They destroy the soil over wide areas, sometimes to a depth of three feet and kill or undermine the trees.

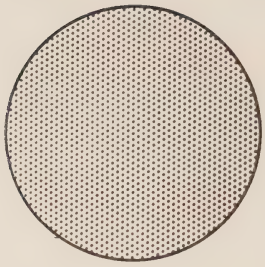
Fire protection is absolutely essential to protect the woodland in the South Nation Watershed. Burning of slash and peat should only be done under permit.

Cutting in woodlots and clean cutting of whole areas has lately been carried on consistently. Most of the woodlots are young growth or second growth of moderate size. The one per cent of mature timber has mostly been fairly severely culled.

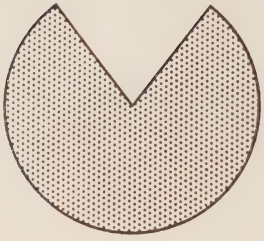
It will be seen that compared with the area of the watershed wooded areas are not extensive, but they add up to over 150,000 acres and are worth preserving and improving. No systematic method has been used in the past, fire has been encouraged rather than controlled and only 4 per cent of the woodland is fenced from cattle.

4. CONSERVATION MEASURES IN PROGRESS: The area of sand in the south part of Russell County, extending eastwards into Prescott, is the largest of several areas throughout the watershed suitable only for forest. County forests have been established here and on a similar but smaller area in Grenville County. There are, besides these two, hundreds of acres of inferior soils which might better be reforested. The beaches of geological lakes usually form long narrow strips often crossing several properties. These are too small for municipal forests but should form useful farm woodlots.

Free distribution of trees for private planting was begun in Ontario in 1905, and a statute was passed in 1906 enabling township councils to exempt



TOTAL WATERSHED
967,528 acres
(100%)

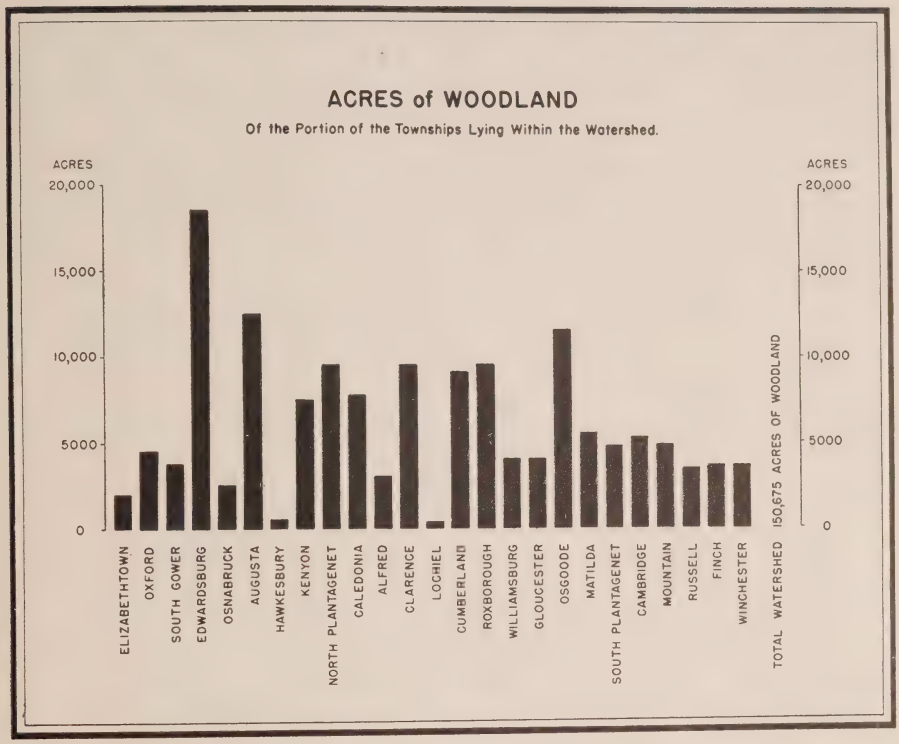


CLEARED LAND
766,426 acres
(79.4%)

WOODLAND
150,675 acres
(15.6%)

WILLOW SCRUB and ALDER
44,727 acres
(4.6%)

BOG (Too wet for Trees)
3,700 acres
(0.4%)



from taxation woodland on a farm up to one-tenth of the total acreage, with a maximum of twenty acres under a single ownership. In 1927 this exemption was made compulsory if applied for and extended to cover plantations as well as natural woods. In 1938 an Amendment to the Assessment Act prevented assessments being raised on account of reforestation. Both these acts were intended to facilitate private planting and should be taken advantage of by those who wish to plant for their own benefit and that of the whole river valley.

The Department of Lands and Forests has divided Southern Ontario into districts and zones, each with an officer in charge, whose duty it is to give advice and help in all forestry matters. The office of the District Forester in this region is Kemptville.

The Kemptville Forest Nursery was established in 1923 in conjunction with the Agricultural School. This served as a distribution centre for Eastern Ontario. The nursery lapsed for a time, but was reopened just before the Second Great War. In 1946 the Eastern Forest Station was opened as a permanent forest nursery on land north of the village of Kemptville.

In the near future it will provide some fine examples of plantations and woodland.

A table in the report gives the numbers of trees distributed for private planting since 1905 to the counties in which the watershed lies. The total for these counties is 5,141,250 trees. Many of these were planted outside the watershed, but the District Forester estimates that 2,200,000 trees were distributed in the watershed up to 1944. The total acreages of private plantations, over one acre, at present is 537 acres. Estimating that these would account for about 649,770 trees, and allowing for many of the trees distributed being used in other ways than for new plantations, it is still evident that a large number have been lost through neglect or improper planting.

The present policy of County Forests was laid down in 1922, and is carried on under the Municipal Reforestation Act. Under this act a municipality may purchase land for reforestation and enter into agreements for its management without any limit as to size. In practice agreements with the Minister of Lands and Forests for planting and managing county-owned land, are not made for less than 1,000 acres. The agreements now in force run for thirty years, the Ontario Government agreeing to establish the forest and pay all the cost of management during that time.

Under the amended Act, townships have the same powers as counties, excepting that of issuing debentures. They may levy, by special rate, a sum not exceeding $1,000 in any year, for reforestation purposes.

The agreement which has recently been drawn up between the Ganaraska Authority and the Ontario Government to establish and manage the Ganaraska Forest is substantially the same as that made with the counties except that the government has agreed to pay half the cost of the land and the agreement for planting and management is to run until the year 2,000 A.D.

The United Counties of Prescott and Russell have established the Larose Forest and the United Counties of Leeds and Grenville the Limerick Forest, both within the South Nation Watershed.

The Larose Forest is one of the largest in the Province and has been established entirely through the efforts of Mr. Ferdinand Larose, Agricultural Representative at Plantagenet. It now comprises 14,416 acres of which 5,000 are planted. It lies mostly in Clarence and Cambridge Townships in the area of poorly-drained sands, once covered with fine stands of pine. This area was swept by the great fire of 1897, after 75 years of lumbering. There has since been some farming, but for the most part it has been uncultivated and fires and pasturing have prevented regrowth. Included in this forest is a separate block in the south-east corner of Cambridge Township, where an attempt to obtain arable land by draining and burning the peat over the clay has proved unsuccessful and much land has been abandoned to pasture and is reverting to willow scrub.

The Limerick Forest, comprising about 2,000 acres was established in 1938. It lies partly outside the watershed, across the height of land between

the South Nation and the Rideau, in Augusta and Oxford Townships. This is an area of poorly-drained sand, with higher ridges which had become completely worn out. The raised areas have been reforested, but much of the rest is a wilderness of scrub willow.

The United Counties of Dundas, Stormont and Glengarry have taken steps to found county forests in Winchester and Finch Townships, and it is hoped that planting of these areas may begin in the spring of 1948.

There are many smaller areas of several hundred acres which are recommended for reforestation. Where these cover whole farms or are source areas, they could be used for small town or township forests or be included in the larger scheme of reforestation recommended as the South Nation Forest under the Authority. Examples of such small forests in the watershed are the following: Plantagenet Village 225 acres, Bourget 94 acres and Gloucester Township 400 acres.

Three townships have established small Demonstration Plantations within the watershed, namely, Edwardsburg, 2 acres; Mountain 12 acres; N. Plantagenet, 11 acres. These plots are intended to demonstrate the use of trees on marginal and sub-marginal land. They must be on a well travelled road and on land owned by the municipality, the government supplying the trees free.

The United Counties of Dundas, Stormont, and Glengarry also established plots in 1939. The original Glengarry plot is at Maxville, the Dundas plot at Chesterville, and the Stormont plot in Osnabruck Township. In 1941 and 1942 six other plots were added to the original three; three in Dundas County, two in Stormont, and one in Glengarry County. These demonstration plots totalled a little over sixty acres in 1948.

Demonstration Woodlots are privately owned areas of woodland on which owners have agreed to follow prescribed woodland management, under the supervision of the Department of Lands and Forests, and to permit access by interested persons. Up to 1946 eleven demonstration woodlots were established within the South Nation Watershed. Two of these have since been discontinued so that there are now nine woodlots of this type in the area.

To encourage the establishment of School Forests, planted and cared for by school children, the Ontario Horticultural Association has offered annual prizes since 1945 for the school having the best plantation and knowledge of forestry in each forest district. Prizes are provided by the Ontario Conservation and Reforestation Association and by Mr. J. E. Carter of Guelph. The winners in the district competition are eligible for the Provincial Forestry Competition. No schools within the watershed have participated in these competitions and no school plots independent of the competition exist within the watershed. Trees have been sent out to schools in all eight counties, but these have been distributed to the children for planting on the home farm and many have been used for windbreaks.

5. FOREST CONSERVATION MEASURES REQUIRED: The most important conservation measure required on the South Nation Watershed is the establishment of large forest areas, to be called the South Nation Forest, under the Conservation Authority, which will serve to cover the great natural water storage areas of the river valley. The next in importance is the establishment of a fire control system under the Authority, to regulate the burning of slash and peat by permit and fight fire anywhere in the watershed.

Twenty-six source and reforestation areas have been defined and are shown on the map. The names of the areas are taken from the streams they feed or from nearby places. They often feed several streams and include more land than the place from which the name was derived.

The total area recommended for this purpose is 198,076 acres of which 82,009 has some form of tree cover, 34,528 acres is willow scrub, 77,839 acres is open land—peat, sand or shallow till, and 3,700 is bog too wet for tree growth.

The twenty-six source and reforestation areas are described in detail in the report and recommendations made for each indicating the measures which are most urgently called for.

Reforestation of forest cover to these lands would not only serve to protect natural water shortage areas and thereby slow down run-off which now causes such disastrous floods, but also would greatly improve the economy of the whole region by growing timber on unproductive land.

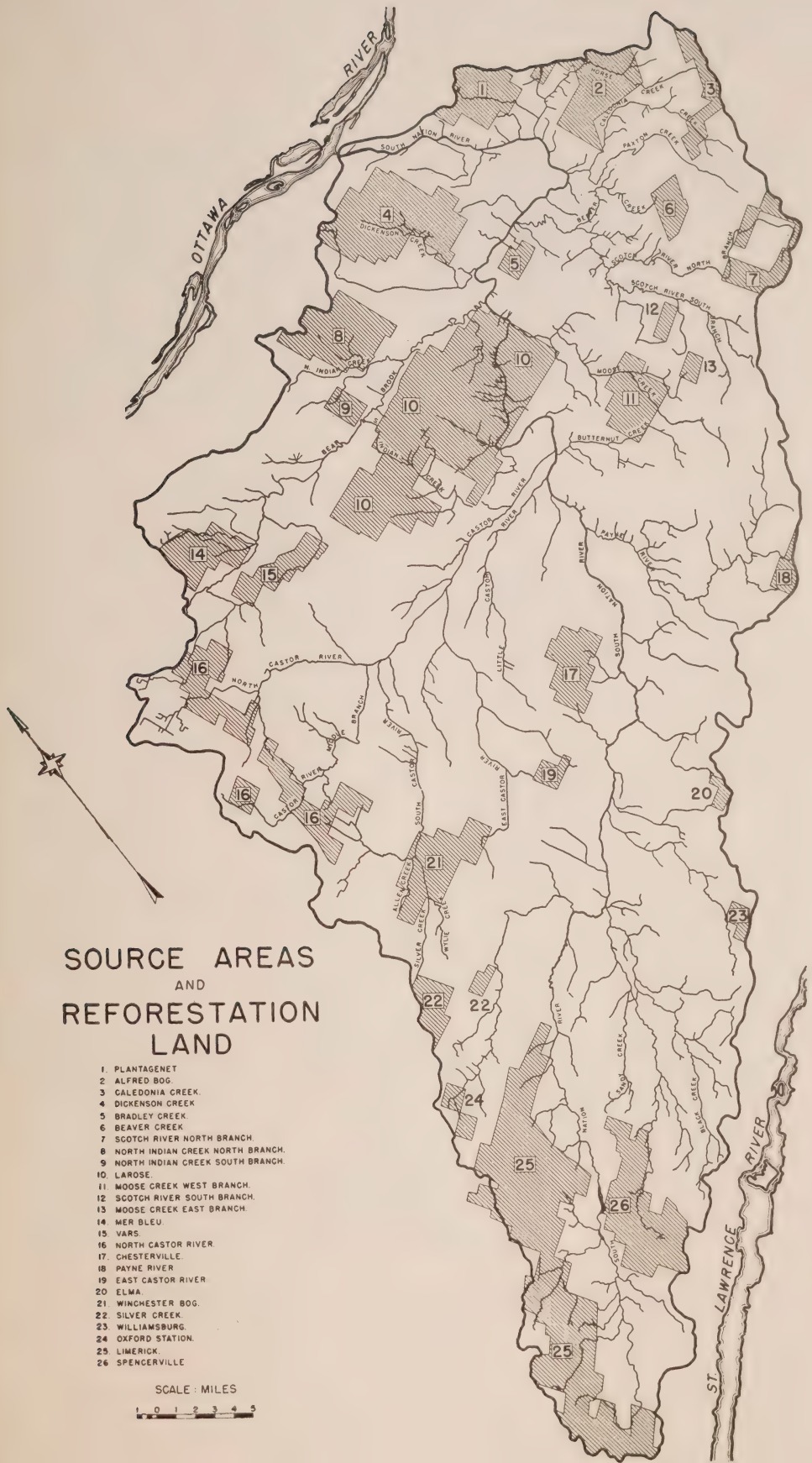
The present woodland on these areas will require little work now, except fencing, but will provide considerable work in improvement cutting when labour is more available. Open land should be planted with trees of suitable species as soon as possible and planting should be carefully planned beforehand. Since many of the areas show a great variation in the degree of moisture, different types of trees can often be planted in one small area.

Research should be undertaken to determine a means of speeding up what appears to be a natural succession from abandoned pasture land through willow scrub and other types of cover to the climax type of silver maple—white elm.

Peat bogs will support stands of trees if not too wet, though most of the bush has been burned off. However, where drainage and burning of peat have increased the amount of drier peat, pioneer types have advanced further into the centre and these will be succeeded by more permanent types of forest cover.

There are, besides these large areas, innumerable small areas forming parts of farms, which will always be in private hands. The total effect of these on stream flow is considerable and they should be planted as woodlots on the separate farms.

Controlled woodlot management of privately owned woodlots must be established in some form before conservation measures can be co-ordinated outside the area of the proposed South Nation Forest. The average owner



SOURCE AREAS AND REFORESTATION LAND

1. PLANTAGENET
2. ALFRED BOG.
3. CALEDONIA CREEK.
4. DICKENSON CREEK
5. BRADLEY CREEK.
6. BEAVER CREEK.
7. SCOTCH RIVER NORTH BRANCH.
8. NORTH INDIAN CREEK NORTH BRANCH.
9. NORTH INDIAN CREEK SOUTH BRANCH.
10. LAROSE.
11. MOOSE CREEK WEST BRANCH.
12. SCOTCH RIVER SOUTH BRANCH.
13. MOOSE CREEK EAST BRANCH.
14. MER BLEU.
15. VARS.
16. NORTH CASTOR RIVER.
17. CHESTERVILLE.
18. PAYNE RIVER.
19. EAST CASTOR RIVER.
20. ELMA.
21. WINCHESTER BOG.
22. SILVER CREEK.
23. WILLIAMSBURG.
24. OXFORD STATION.
25. LIMERICK.
26. SPENCERVILLE

SCALE : MILES

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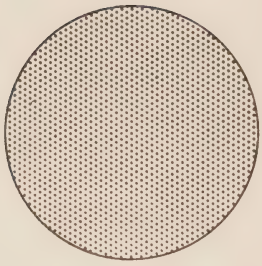
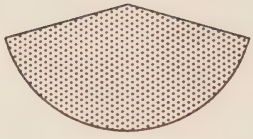
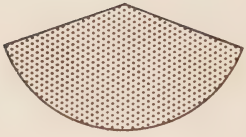


TOTAL SOURCE AREAS
198,076 acres
(100%)



WOODLAND
82,009 acres
(41.4%)



CLEARED LAND
77,839 acres
(39.2%)

WILLOW SCRUB and ALDER
34,528 acres
(17.4%)

BOG (Too wet for Trees)
3,700 acres
(2.0%)

does not take a wide view of the value of forest cover for protecting stream flow. As a result the systematic cutting, both for lumber and firewood, which has been going on for many years, has done a great deal of damage. The system of selling blocks of timber for fuelwood is another vicious practice, since it almost always leads to complete clean-cutting. This situation should be corrected and areas connected in any way with the headwaters of streams should be controlled so that they cannot be clean-cut.

Provision is now made in the statutes of the Province under "The Trees Conservation Act" which permits a county to pass a by-law regulating the cutting of trees on private land. Fifteen counties in Ontario have passed such a by-law, but of the counties forming part of the South Nation Watershed only the United Counties of Leeds and Grenville have done so up to the present.

The most progressive forestry action taken in Ontario since the establishment of an effective fire fighting force was taken by the County of Halton in 1948, when the County Council passed a by-law to aid farmers in fencing their woodlots from livestock.

The by-law states that the County of Halton will grant a sum equal to the prevailing cost price of 8-strand fence wire with a single barb (not the cost of posts or labour) to a woodlot owner who will erect such a fence on one or more sides of his woodlot in order to completely enclose the woodlot, thus fostering forest growth by keeping livestock out. The woodlot must be of a size not less than two acres and livestock must be excluded for a minimum period of ten years.

Such action by the County Council is of infinitely more value than the planting of many trees artificially. It is recommended that the South Nation Authority adopt a similar scheme.

6. FOREST INSECTS AND DISEASES: In any project, such as proposed for the watershed, careful consideration should be given to the prevention of insect outbreaks and tree diseases, and arrangements made for control measures when necessary. There are a number of fundamental principles which will greatly lessen the destructiveness of these pests, which are set forth in the full report.

7. LAND ACQUISITION: The problem of land acquisition should be approached carefully. It is not the practice in Ontario to overrule personal rights of ownership under the principle of eminent domain except to carry out works urgently required for the general good. The acquiring of poor land in the South Nation Watershed for reforestation may certainly be placed in this class and requires a more permanent authority than the individual to return it to its proper use. However, the problem should not be approached in a dictatorial manner and the willing co-operation of the people of the area should be secured by full explanation of the scheme and demonstration of its future benefits to the community.

The only part of the watershed where large scale transfers from private ownership to the Authority would have to be made are those areas which are

recommended as source areas and reforestation land. The best farms in these areas need not be entirely withdrawn from agriculture, where upkeep of public utilities is not too heavy. They could be incorporated in the forest as farmland and used by forest workers, since both farming and forest work are seasonal to some extent.

There are several methods of acquiring land for conservation purposes. It may be transferred to the Authority by ordinary private sale, a maximum price per acre beyond which the Authority is prohibited to go might be set, or in some cases long-term agreements could be made with the owners for control of such parts of their lands as fall within the forest scheme. As a last resort, the Authority has the power to expropriate land for conservation purposes under the Conservation Authorities Act of 1946.

As an indication of the approximate cost of land for forests, a table showing the average cost per acre paid for reforestation land by counties and one authority is included in the report. The average for the 37,108 acres in the table is $4.36 per acre. This includes some land comparatively close to Toronto for which a much higher average price was paid. Where the lands to be purchased include large areas of nearly useless sand, much of it already tax delinquent, a lower average price might fairly be paid. This was the case with the Larose and Limerick forests.

While the establishing of such forests on the South Nation Watershed would be a longtime program requiring the spending of large sums of money, much of the land which is indicated for this purpose is useless for agriculture. A forest on the other hand is a crop and a crop brings returns and many of these areas in the future could be the centre of a thriving forest community. The following are two such examples.

In Nova Scotia there is a community living on Hammonds Plains near Halifax which depends entirely on wood taken from small woodlands for its livelihood. In this settlement the largest woodlot is not over 400 acres in extent and because of the rocky nature of the soil the people are not able to augment their incomes by farming, though most families own a cow, a pig and some chickens. The wood from the woodlots is manufactured into barrels and boxes by more than twenty small mills which are largely family owned and operated. The people are thrifty and industrious; they have comfortable homes, are public-spirited and extremely forest fire conscious. This is a community which has developed naturally and yet resembles communities based on a forest economy which have been planned and established in Europe for a considerable time.

One of the most recent is the forest of Ae in Dumfriesshire, Scotland. It was established by the British Forestry Commission in 1927 and covers an area of 10,683 acres of which 3,000 acres has been planted, 4,500 acres is scheduled for planting in the near future, 250 acres of the best land has been set aside for cultivation and the balance of 2,800 acres is unplantable because of its altitude but is used for sheep pasture in summer.

The forest is in charge of a forester who resides on the property assisted by a foreman and necessary workers. In the first year sixteen men were

employed, just before the war twenty-seven full-time employees were engaged, and by 1960 about ninety men will be needed the year round for essential forest work. This does not take into account temporary employees who will be required for saw milling, transport and other jobs. It is planned to create a forest village for the workers embodying a church, a school, playgrounds and sports-fields. The combination of the forest and the village dependent on it, is something new in Scotland and represents an important start in the resettling of men and women in the country. The village is to be the forerunner of other similar villages and in many parts existing villages will be revitalized by the stimulus of forest wealth.

SCRUB AREAS AND BOGS
(In Acres)

Township	Willow	Gray Alder	Bog[1]	Hawthorn
Alfred	23	....	663	..
Augusta	3,499	134	100	30
Caledonia	757	9	357	..
Cambridge	9,555	329	....	..
Clarence	2,070	549	29	..
Cumberland	1,655	776	375	..
Edwardsburg	3,349	603	458	..
Elizabethtown	141	....	....	8
Finch	399	36	....	..
Gloucester	1,930	182	1,718	..
Kenyon	349	....	....	..
Lochiel	....	....	....	..
Matilda	1,657	....	....	21
Mountain	5,810	59	....	..
N. Plantagenet	1,970	126	....	..
Osgoode	2,187	29	....	..
Osnabruck	316	55	....	..
Oxford	869	136	....	..
Roxborough	1,638	....	....	..
Russell	528	271	....	..
S. Gower	480	17	....	..
S. Plantagenet	760	30	....	..
W. Hawkesbury	....	....	....	..
Williamsburg	223	....	....	..
Winchester	1,088	66	....	..
Total	41,253	3,415	3,700	59

Total Scrub Land 44,727 acres or 4.6%.

[1]Not capable of supporting forest cover.

PART IV—WATER

1. HYDRAULICS—GENERAL CONSIDERATIONS

1. CAUSES OF FLOODING

There are many physical features on that part of the South Nation Watershed above the Village of Chesterville, which contribute to flooding. There are no natural lakes, few swamps where needed, and above Brinston the soil for the most part is a shallow till with extensive rock outcrops around the outside of the area. The smaller streams leading into the central part of the area are steep, while the central area around Brinston is so flat that the run-off is very sluggish. All of the above features tend to cause flooding. The rains run off quickly and the river itself is an inadequate channel to carry off the heavy flood concentrations. Added to this is the fact that the river gradient is very flat for several miles above Chesterville.

Floods occur after the spring thaw but have also occurred after heavy summer and fall rains. Ice jams in the spring have further aggravated flood conditions at certain points.

2. THE EXTENT OF FLOODS IN BRINSTON AREA

The main flooded area which is north of Brinston is shown on the map—Figure H-3. This map indicates the area which was flooded in 1938. The high water mark reached the 238-foot contour[1] which meant a maximum depth of water over the land of nine feet. Many dwellings had two or three feet of water over their ground floors. The 1947 flood is reported to have been just about as severe. The 1938 and 1947 floods were the greatest on record although flooding of varying magnitude occurs almost every year. As has been stated, these floods are not confined to the spring freshets but have also occurred after heavy summer storms. In fact, those which occur after seeding time are perhaps most damaging. It is reported that at least one farmer lost crops four years in succession through flooding.

Floods during spring freshets cause inconvenience, hardship and often distress, but they are anticipated and farmers do what they can to meet the threat. Livestock and supplies are moved to upper floors or other safe locations and seeding is delayed until the spring floods are past. The duration of these floods from the time of overtopping the bank to the recession below the banks has lasted for as long as nine and one-half days.

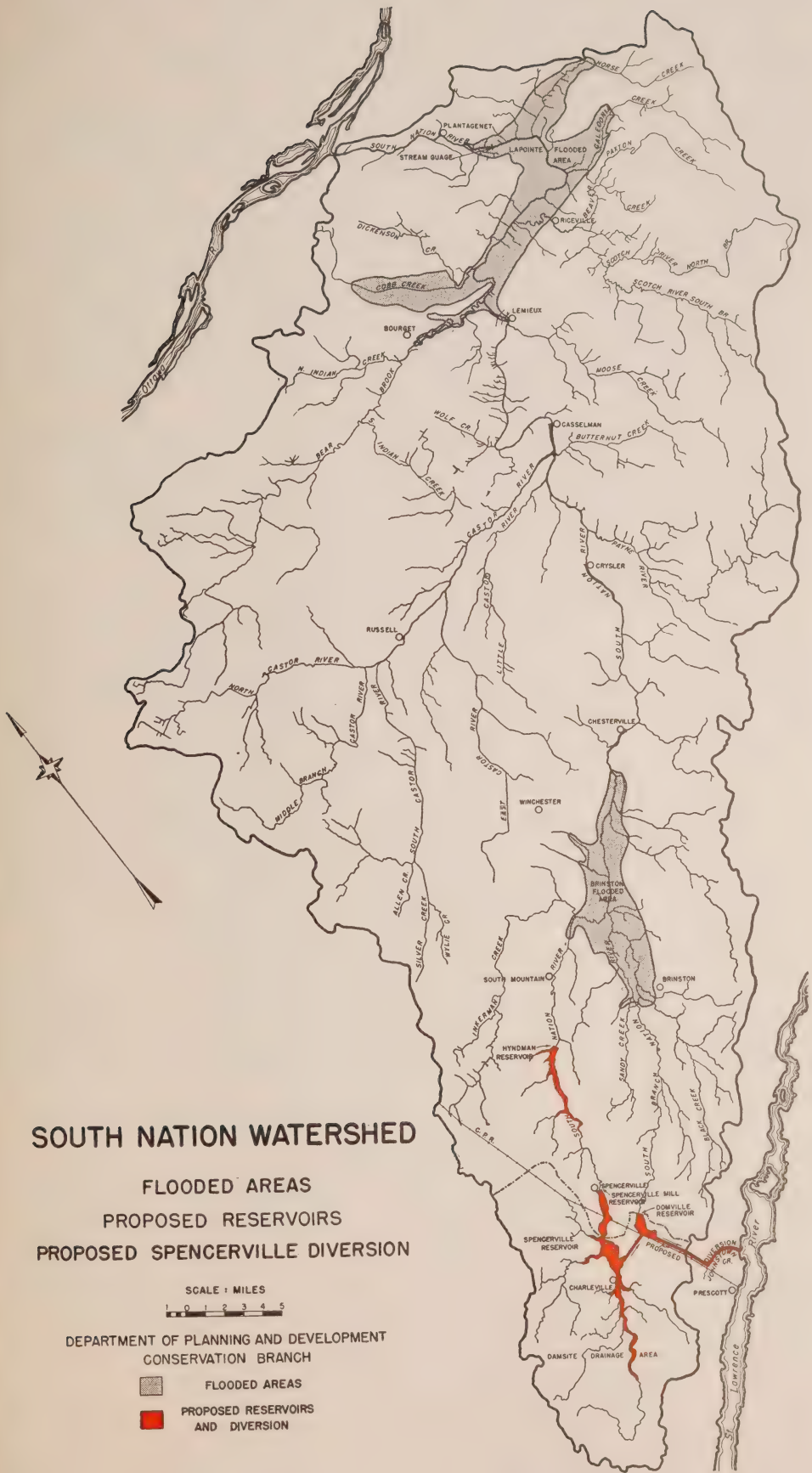
3. RUN-OFF AND FLOW

Run-off is the rate at which precipitation (rain, melted ice and snow) runs off a watershed area, and the run-off is usually expressed as cubic feet per second[2] per square mile (c.f.s. per sq. mi.).

Before any proper provision for flood control can be made, a dependable rate of run-off must be determined for the maximum flood expected to occur

[1] Contours—lines used on maps to show hills and valleys; i.e., the topography of the area—actually a contour is a line running through all points of equal elevation.

[2] Cubic feet per second—a unit of measurement for determining the amount of water flowing in a stream; i.e., the number of cubic feet of water passing a given point each second.


SOUTH NATION WATERSHED
FLOODED AREAS
PROPOSED RESERVOIRS
PROPOSED SPENCERVILLE DIVERSION
SCALE : MILES
1 0 1 2 3 4 5
DEPARTMENT OF PLANNING AND DEVELOPMENT
CONSERVATION BRANCH
FLOODED AREAS
PROPOSED RESERVOIRS AND DIVERSION
PLANTAGENET
STREAM GUAGE
LAPOINTE FLOODED AREA
RICEVILLE
LEMIEUX
BOURGET
CASSELMAN
CRYSLER
RUSSELL
CHESTERVILLE
WINCHESTER
BRINSTON FLOODED AREA
BRINSTON
SOUTH MOUNTAIN
HYNDMAN RESERVOIR
SPENCERVILLE SPENCERVILLE MILL RESERVOIR
DOMVILLE RESERVOIR
SPENCERVILLE RESERVOIR
PROPOSED DIVERSION
CHARLEVILLE
PRESCOTT
DAMSITE DRAINAGE AREA
SOUTH NATION RIVER
COBB CREEK
DICKENSON CR.
SCOTCH RIVER NORTH BR.
SCOTCH RIVER SOUTH BR.
MOOSE CREEK
BUTTERNUT CREEK
W. INDIAN CREEK
E. INDIAN CREEK
WOLF CR.
BEAR BROOK
CASTOR RIVER
NORTH CASTOR RIVER
MIDDLE BRANCH
SOUTH CASTOR RIVER
LITTLE CASTOR RIVER
CASTOR RIVER EAST
SOUTH CASTOR RIVER
ALLEN CR.
SILVER CREEK
WILLIS CR.
SOUTH MOUNTAIN CREEK
SANDY CREEK
SOUTH BRANCH
BLACK CREEK
C.P.R.
JOHNSON CR.
St. Lawrence River

over a long period of years. It is from this flood rate that necessary reservoir capacities, heights of dams, spillway capacities and channel improvements are calculated.

The flood flow rate is obtained in the first instance by actually gauging the stream or river. So-called stream gauges are installed at strategic points along the river and these gauges should be read daily over a period of years. Meterings of the flow are also obtained at the various points in the river. Using these records it is possible to predict the magnitude and duration of the largest floods to be anticipated. Having made the determination of the size of flood to be handled, it is then possible to proceed to investigate flood control measures.

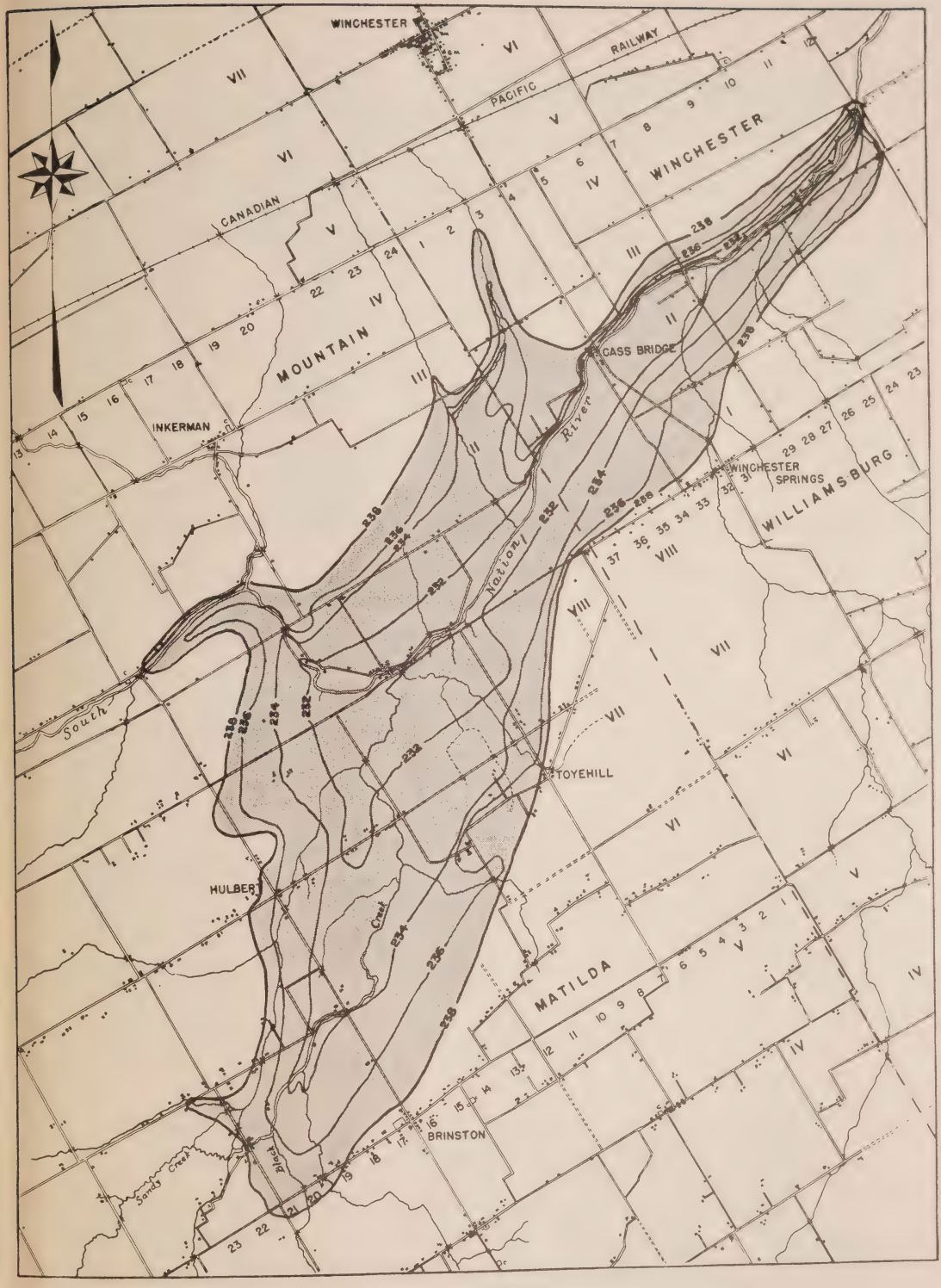
On many of the larger rivers of the province the flow gauges are installed and maintained and records kept by the Dominion Water and Power Bureau, Ottawa. Recently gauges have been installed on many other rivers at the request of the Department of Planning and Development of the Province of Ontario and the operation of these gauges used for flood control purposes is paid for co-operatively by the two above-named departments.

In general, the value of flow records increases with the number of years of record. Records covering a period of from 25 to 35 years are most valuable since they are likely to include periods of highest as well as lowest flows. By plotting the long term flows on frequency charts, it is possible to estimate the maximum floods which might be expected in 15, 50, 100 or 1,000 years. Such a computation has been made for the South Nation River and will be discussed below.

A gauge has been in operation near Plantagenet Springs since 1915, a period of 32 years, hydrographs of which have been prepared for each year. Provision for a flood that might occur once in one hundred years is believed to be desirable and economically possible. The magnitude of such a flood has been computed to be 42,500 cubic feet per second. This represents a run-off for the whole watershed above Plantagenet which has an area of 1,477.46 square miles, of 28.77 c.f.s. per sq. mile.

Obviously the rate of run-off for any particular part of the watershed may differ from the average rate for the whole area depending upon the physical features of the terrain. It is thought that the run-off rate may be higher than 28.77 c.f.s. per sq. mi. for the steeper outside areas of the watershed and lower for the central part which might be termed the Winchester Flats. In order to check these assumptions, gauges have been installed at Spencerville and Chesterville. When the results are obtained from these gauges a more accurate estimate of run-off will be possible.

In the meantime, in order to make a study of flood correction methods the following assumptions have been made. It is estimated that the maximum run-off from the steeper periphery of the watershed will be in the neighbourhood of 35 c.f.s. per sq. mi. with a corresponding rate from the Winchester Flats of 18.95 c.f.s. per sq. mi. These values will be used in the present report and should not require drastic alteration at a later date.



SOUTH NATION WATERSHED

BRINSTON FLOODED AREA

1938 FLOOD

4. BASIS OF FLOW RECORDS

The basis of flow records obtained for the area will be the records obtained at the Plantagenet gauge during the 1947 flood. The total run-off for the 1947 flood was greater than that of the 1938 flood although the latter flood reached a higher peak. The peak of the 1938 flood was thought to have been caused by ice jams which held back the water and then unleashed a very high surge when they broke. Such a surge took out the Lemieux Bridge.

The following Table H-1 shows the peak flow.

TABLE H-1

PEAK FLOWS

Flood Year	Peak at Plantagenet	Peak at Chesterville	Peak at Spencerville Dam†
1938	41,610 c.f.s.	11,520 c.f.s.	3,395 c.f.s.
1947	38,030 c.f.s.	10,529 c.f.s.	3,103 c.f.s.
Maximum Flood once in a 100 years.	42,500 c.f.s.	11,767 c.f.s.	3,468 c.f.s.

†This is not the present Mill Dam at Spencerville but a new proposed dam further up stream.

From this table it will be seen that maximum flow at Chesterville less the flow at the Spencerville dam would be 8,299 c.f.s.

5. STORAGE REQUIRED

The amount of storage required to prevent flooding is that volume of water which the river valley is unable to contain within its banks. When the flood flow has arisen to an elevation where it just begins to overflow the banks of the river, it has reached a stage which is termed "critical flow." This would be the maximum flow which can be contained within the river channel without flooding. If the time is observed when the flow rises to the elevation where it just begins to overflow the banks, and later the time noted when it recedes to the same elevation, and these times are integrated with nearby gauge readings, a very useful relationship is obtained which makes it possible to estimate the amount of storage required in acre feet.[1]

The values so obtained for the critical flows, duration of flood and required storage necessary to prevent flooding in the Brinston area are shown in Table H-2 below:

TABLE H-2

Flood Year	Critical Flow	Duration of Flood	Storage Required
1938 Flood	4,360 c.f.s.	9.43 days	65,440 acre feet
1947 Flood	4,360 c.f.s.	9.48 days	72,180 acre feet
Maximum flood once in 100 years	4,360 c.f.s.	10.1 days	90,626 acre feet

The above results have been obtained by using the Plantagenet gauge readings and making the best possible estimate of the difference in location

[1]Acre Feet—a unit used for measuring water in a reservoir, one acre foot is one acre covered with one foot of water or 43,560 cubic feet of water.

upon the flows at Brinston. When gaugings are available at Chesterville and Spencerville slight modifications of the above figures may be necessary.

2. SOLUTION OF THE PROBLEM

In searching for ways of solving the hydraulic or river problem on that part of the South Nation Watershed above Chesterville the following objectives have been kept in mind: First, the prevention of flooding on the Brinston Flats and other areas farther down the watershed, and second, the providing of water for summer flow, thereby flushing the river channel as an aid to sanitation; providing more water for agriculture and increasing the water supply for industrial purposes at Chesterville.

1. METHODS OF CONTROL

To achieve these objectives the following hydraulic methods are proposed:

(a) *Dams and Flood Storage Reservoirs*

Dams and flood storage reservoirs are one means of controlling floods. The method of using dams is well illustrated by those of the Muskingum Conservancy District in Ohio and by the Shand Dam on the Grand River in Ontario. The method consists of creating an artificial lake by the construction of a dam. The water is impounded during a flood, thus relieving points downstream. The impounded water may then be released after the flood passes, or part of the water may be held back to provide summer flow.

All possible sites for field control reservoirs above the village of Chesterville have been investigated in the flood. While there are a large number of possible sites, most of them are small and would not be useful in the control of floods since they fill under present flood conditions and would not therefore provide sufficient additional storage even if dams were built on them.

The only sites which are considered valuable for flood control purposes are at a site above the present dam at Spencerville (referred to hereafter as the Spencerville Dam), at the present Mill Dam at Spencerville (referred to hereafter as the Spencerville Mill Dam), at Domville and at Hyndman.

These sites are shown in Figure H-2. It will be noted from this plan and also Table H-3 that the capacities of all these reservoirs except Spencerville are relatively small. In addition to the above improvements for storage it is also desirable that the dam at Chesterville be redesigned.

(1) Spencerville Reservoir

The Spencerville Reservoir has an area of 2,673 acres or 4.18 square miles and the proposed dam is two and one-half miles southwest of the village of Spencerville. The dam would lie adjacent to the road through Lot 35, Concession VI, Township of Edwardsburg. The roadway would be carried over the dam. It should be noted that the proposed location of the dam is above the Ottawa-Prescott Canadian Pacific Railway line, and not at the location of the present mill dam at Spencerville. Location of the proposed new dam at the site of the present dam would mean the loss of some 10,450 acre feet

of storage due to limitations in level imposed by the railway grade. From the proposed dam, the reservoir extends southerly and when full would be approximately eight and one-quarter miles long and from one-quarter to one-half mile in width. The dam would be 22.5 feet in height.

The estimated cost of the dam and reservoir at present-day prices would be $234,000.

(2) Spencerville Mill Reservoir

The dam for this reservoir would be located at the site of the present dam and would be 15 feet high. Since the storage impounded by this dam, namely 1,748 acre feet, would be relatively small, the construction of a new dam could be left until the more important parts of the total scheme had been completed. The estimated cost of reconstruction is $58,600.

(3) Domville Reservoir

This reservoir with a capacity of 2,449 acre feet is located about two and one-quarter miles due east of Spencerville damsite and two and one-half miles southeast of the village of Spencerville in Lot 28, Concession IV, near the front of the Concession, Township of Edwardsburg. When full the reservoir would be 2.4 miles long and one-quarter to one-half miles wide. Part of the westerly limit of the reservoir borders on the Canadian Pacific Railway. Most of the cover of the area is swamp or willow scrub bush. The dam which is 18 feet high would not be a costly one, since the required discharge from the reservoir through the dam would be small. Its estimated cost would be $39,400.

(4) Hyndman Reservoir

This is also a relatively small reservoir having a storage capacity of 1,760 acre feet with a dam 14.5 feet high. The estimated cost would be $41,700.

(5) Chesterville Dam

It would seem to be advisable to redesign and rebuild this dam so that it could be provided with sluiceways which could be opened at any season of the year during floods. As this dam is neither high nor wide, the cost of rebuilding would not be excessive.

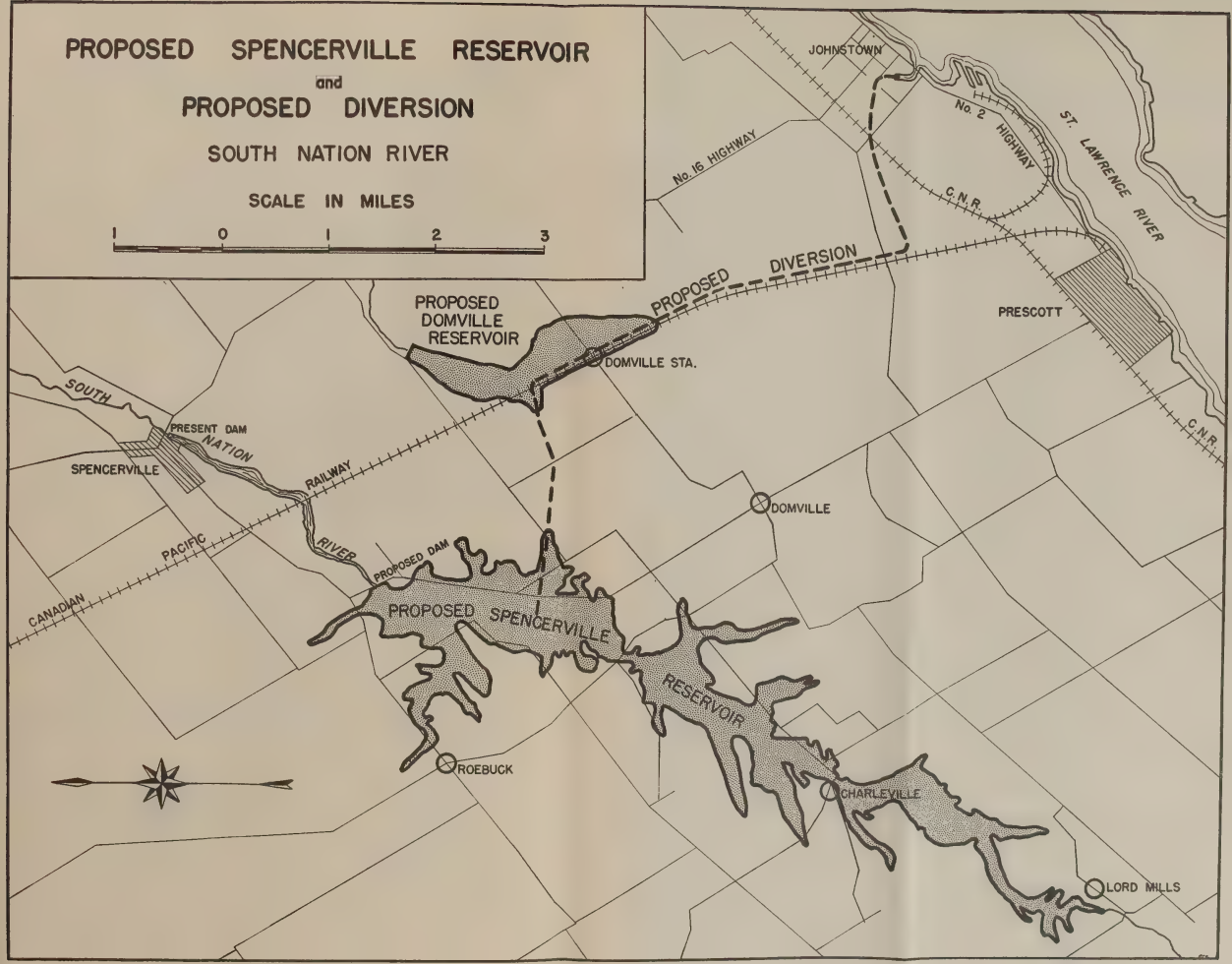
(6) Effect of the Above Storage on Flood Control

In Table H-2 is shown a figure of 90,626 acre feet as the required storage to prevent a maximum flood and protect the Brinston area. The storage available if the above reservoirs were constructed would be as indicated in the following table:

TABLE H–3

STORAGE CAPACITY

Spencerville Reservoir	12,776 acre feet
Spencerville Mill Reserve	1,748 acre feet
Domville Reservoir	2,449 acre feet
Hyndman Reservoir	1,760 acre feet
Total	18,733 acre feet


PROPOSED SPENCERVILLE RESERVOIR
and
PROPOSED DIVERSION
SOUTH NATION RIVER
SCALE IN MILES
1 0 1 2 3
JOHNSTOWN
No. 16 HIGHWAY
No. 2 HIGHWAY
C.N.R.
ST. LAWRENCE RIVER
PROPOSED DIVERSION
PROPOSED DOMVILLE RESERVOIR
DOMVILLE STA.
PRESCOTT
C.N.R.
SOUTH NATION RIVER
PRESENT DAM
SPENCERVILLE
RAILWAY
CANADIAN PACIFIC
DOMVILLE
PROPOSED DAM
PROPOSED SPENCERVILLE RESERVOIR
ROEBUCK
CHARLEVILLE
LORD MILLS

Thus, it may be readily seen that the total available storage is only slightly over twenty per cent of the amount required to control floods properly. It is thus apparent that further measures might be sought to dispose of this extra amount of water.

(b) Diversions

A diversion is useful if it can be constructed economically enough and will relieve the flooding in a given situation. It consists of a channel or canal which carries the excess water to another part of the area where it can be disposed of without damage to property or to another watershed.

The only portion of the South Nation Watershed above Chesterville where it is possible to make a diversion is that segment south of and roughly in line with the village of Spencerville. The Spencerville and Domville reservoirs are within this segment and a diversion channel from the Spencerville reservoir to the St. Lawrence River could also connect with the Domville reservoir and thus divert flood waters which would normally add to the floods in the Brinston area and farther downstream.

The route shown should be regarded as only a tentative one as further studies would be necessary before finally fixing the location. The diversion route as shown starts at the Spencerville reservoir and cuts across to the Ottawa-Prescott branch of the Canadian Pacific Railway. It follows the railway for about 3.8 miles, passing through the Domville reservoir, and leaves the railway at Johnstown Creek, which it follows to the St. Lawrence River. It has been designed for a flow of 3,000 c.f.s. at velocities which will not erode the earth banks. The channel is 48 feet wide at the bottom, has a minimum height of 11.5 feet with $1\frac{1}{2}$: 1 side slopes in earth and is approximately 8.14 miles in length.

A stretch of railroad 1.9 miles in length would be flooded by the Domville reservoir and the grade would have to be raised eight feet approximately. Some excavation from the canal could be used for the necessary railway fill, the remainder could be disposed of along the banks of the channel. It would be necessary also to provide control works in the canal as well as some means of dissipating energy at a drop where the canal enters Johnstown Creek. The estimated cost of this diversion is $1,200,000.

It is estimated that this diversion would have the same effect in the prevention of floods as that of a reservoir of 34,402 acre feet capacity. Thus the total effect of the proposed reservoirs and the diversion would be to provide storage or equivalent storage as follows:

TABLE H–4

Storage equivalent of the diversion	34,402 acre feet
Spencerville Reservoir	12,776 acre feet
Spencerville Mill Reservoir	1,748 acre feet
Domville Reservoir	2,449 acre feet
Hyndman Reservoir	1,760 acre feet
Total	53,135 acre feet

Since the storage required for proper control of the maximum floods at Brinston is 90,626 acre feet, there remains an amount of 37,491 acre feet (90,626-53,135), which is not taken care of by the combined effect of the reservoirs and the diversion. It is well to note that 37,491 acre feet constitute 41.4 per cent of the total storage required and means that the flood waters would rise approximately to an elevation of 235.3 and flood approximately 14.7 square miles or 63.25 per cent of the Brinston area. This would mean a maximum depth of flooding of six feet as compared with nine feet without the reservoirs and diversions.

(c) Grading of a River Bed

Grading is sometimes done where the flow capacity of a river can be increased by improving the grade of the river bed by excavation. This excavation would speed up the rate at which flood water could run off the flooded areas. A consideration of the matter of straightening certain sections of the channel might also be involved. Such work, however, must always take into account the disposal of this increase in flow farther down the river.

As has been stated above, the proposed reservoirs and diversions are not all that would be required to reduce the flood crest to safe values. It is recommended further, therefore, that the river channel be widened and deepened from 5.5 miles below South Mountain to a point 1.6 miles above Chesterville Dam. A preliminary estimate indicates that 1,470,000 cubic yards of material would need to be removed from the river channel in order to contain the flood waters within the channel. It is proposed that the material excavated from the channel would be disposed of along the river banks and might be planted with trees. A preliminary estimate of the cost of this work is $639,000.

(d) Dikes

Dikes are artificial barriers of earth or masonry sometimes built along a river to keep flood waters within the channel. Usually they are costly structures if built for any distance. In addition if the surrounding country is low-lying, as is the case near Brinston, a very costly pumping problem would be encountered in raising water into the river from the land behind the dikes. They would also interfere with the farm drainage of such low lands.

In the opinion of those responsible for this report the last method, namely dikes, would be too costly and therefore has been discarded as a method of solving the problem in this part of the watershed. The first three, however, namely reservoirs, a diversion and a moderate amount of dredging, were considered practicable and not too costly for the result to be achieved, and are offered as a solution to the problem.

TABLE H–5

DAMS AND RESERVOIRS

Name	Storage in Acre Feet	Height of Dam	Estimated Cost of Dam and Reservoir	Cost per Acre Foot
Spencerville	12,776	22.5	$234,000.00	18.30
Spencerville Mill	1,748	15.0	58,600.00	33.50
Domville	2,449	18.1	39,400.00	16.10
Hyndman	1,760	14.5	41,700.00	23.70
Total	18,733		$373,700.00	

TABLE H–6

COST OF RECOMMENDED HYDRAULIC WORKS

Works	Costs
Dams and Reservoirs—Spencerville, Spencerville Mill, Domville and Hyndman	$ 373,700.00
Diversion	1,200,000.00
Improving the channel below Brinston	639,000.00
Total	$2,212,700.00[1]

(2) SUMMER FLOW

As has been previously stated, the maintenance of adequate flows in the river during the summer months would be desirable in order to provide for flushing out the channel as an aid to sanitation, providing water for agriculture and supplying water for industrial requirements.

During many summers the flow in the river above Chesterville has fallen to negligible values. The driest year on record was 1931 when the indicated mean monthly flows at the Plantagenet gauge were for June, 198 c.f.s., July, 21 c.f.s., August, 10 c.f.s., September, 10 c.f.s., or an average minimum daily flow for the four months of 60 c.f.s. The corresponding flows above Chesterville would be much less than the above. In fact the river bed has become almost completely dry during many summers at various points above Chesterville.

The low summer flows can be augmented if it is possible to store water in reservoirs during periods of high flow and later release the water during drought periods. If the proposed Spencerville diversion is built, it would be possible to keep a sufficient supply of water in the Spencerville and Domville reservoirs, which would be augmented by summer rains, to supply continuous summer flow. The diversion would be used to handle any flash floods that might occur and the water impounded by the above two reservoirs could be released during the dry summer months.

The combined capacity of these two reservoirs is 15,226 acre feet. The dry season from June 1st to September 30th comprises 122 days. The above storage would supply, when combined with Spencerville Mill reservoir, an added average daily discharge at Spencerville of 70 c.f.s. during the entire

[1]Costs as of January, 1948.

122 days of low flow or a greater flow than at Plantagenet in the driest year on record. A rainy season would further increase this available flow.

At some future date it might be necessary to consider still more summer flow in the upper part of the river and small reservoirs might be built at Algonquin, Glenmore, Roebuck and Keller's Creek.

PART V—WILDLIFE

1. THE APPROACH TO THE PROBLEM: The two objectives in planning for wildlife in Southern Ontario are to allow the average citizen to hunt, fish and trap for profit, and to allow him to see and enjoy the wildlife of the region in the greatest possible variety. There should be a permanent population of interesting species, an annual crop of game and fur, control of harmful species and maintenance of other animal populations at a desirable level by providing a proper "habitat." This is the outcome of good land management. For the purposes of this report it is assumed that providing suitable habitats is at present the chief wildlife problem of the South Nation River.

   Sound wildlife planning requires a detailed study of individual species and their habitats, and a study of the changes of populations over a period of several seasons. As the second requirement was beyond the scope of a single year's survey, it was decided to concentrate the field work on a few more significant problems. The watershed covers more than 1,500 square miles and provides a great variety of wildlife habitats. The streams also show a great variety. The scope for fish and wildlife study is therefore very great. Basic research on game environments in agriculture has only recently begun in Southern Ontario, while the techniques of stream survey are further advanced. The chief detailed work of the survey was therefore done in stream biology and the environment for fish.

   Three other species of wildlife were also selected for special attention—namely, the muskrat, the most important fur-bearer, the meadow vole (meadow mouse), potentially harmful to reforested areas, and the grey partridge, one of the best game birds in North America which is known to be established in the watershed.

2. FORMER CONDITIONS: It is a common belief that the dense forests, which covered almost all of the watershed at the time of settlement, were full of wildlife. It is unlikely that many species were very numerous except the black squirrel. The dense stands of pine in the northern part of the watershed certainly could not have supported much wildlife. It seems more probable that the maximum of game and larger forms occurred some twenty years after settlement, when the partly cleared country offered a wide variety of food and shelter. Gradually further cutting, with extensive trapping and hunting reduced the wildlife, while the lowering water table cut off many springs and seriously reduced fish life in the streams.

   Meanwhile open-country species of game and fur were increasing. The cottontail entered the watershed from the west about fifty years ago. The beaver, once very plentiful on the Castor River, had been exterminated before 1825.

There are surprisingly few early records of the fish and wildlife of the watershed. Seven species, which do not now occur, must have ranged over the watershed in early times. These are the marten, fisher, wolverine, beaver, cougar, Canada lynx and wapiti or elk. The harbour seal may have entered the mouth of the river from the Ottawa River which they occasionally ascend in early winter as far as Ottawa.

3. STATUS OF PRESENT SPECIES: A list of 53 mammals present or formerly present in the watershed is given in the report. Since no intensive collecting is known to have been done in the watershed, the list is partly hypothetical. Twenty-six species were collected or observed during the survey. Seven more are reliably reported in the past, but are now extinct in the area. Twenty should certainly include the watershed in their range, but have not been reliably reported.

No intensive survey of birds was possible, but during the survey 115 species were observed. This is far short of the total number of species which must occur. The list of 235 bird species given in the report therefore includes all birds which have already been recorded near the city of Ottawa, less than twelve miles from the edge of the watershed, and which may reasonably be expected to occur in the watershed. One species, the Passenger Pigeon is extinct.

General statements concerning the wildlife populations in the watershed are apt to be misleading. The area differs widely from most in Southern Ontario. The woodlands (over 15 per cent) are not dotted over the area and there are many great areas of open farm land with few or no woodlots and many "clean" wire fences. Most of the farm woodlots are grazed. Much of the land is therefore nearly barren of wildlife, while the blocks of woodland and bog carry fair populations of game and fur along their edges. However, a few notes on the chief species are given in the report. White-tailed deer, raccoon, red fox, and skunk were found in considerable numbers. The varying hare was fairly numerous in 1947, while the cottontail was widely distributed but not abundant. No European hares were reported. Mink, weasels and ruffed grouse were somewhat scarce, while woodcock and snipe were very scarce. Moose, black bear, bobcat and otter sometimes occur but are rare.

Very few wild duck breed in the area. Satisfactory habitat is almost entirely lacking except for a small area of marshes above Spencerville. Many must cross the watershed to reach the more attractive territory which surrounds it.

The Ruffed Grouse (Partridge) populations vary considerably from year to year. It is probable that illegal shooting prevents any high population peak.

The early attempts to introduce the Hungarian Partridge into this continent, beginning in the eighteenth century, were mostly failures. Later attempts, however, have been successful in some localities, both in the United States and in Canada.

In the South Nation Watershed the Hungarian Partridge has a wide

range. Nesting and wintering of coveys are reliably reported from five of the western townships of the watershed. However, a severe ice storm recently caused a heavy mortality, especially in Augusta Township.

A small strip survey was undertaken in several parts of the watershed, which showed a maximum estimated population for the areas surveyed of four coveys or about fifty-six birds per 1,000 acres. For a considerable area centering on Winchester, the average density was 1.6 coveys per 1,000 acres. A census of this type, on a greater scale and therefore less liable to wide error, should be carried out, both in spring and fall, as a prerequisite of good management.

Because of its breeding habits and tolerance of a high degree of land cultivation the Hungarian Partridge should be encouraged as a game bird. Further studies of its requirements are needed in order to learn the best means of accomplishing this. The daily or seasonal bag limits and number of licenses to hunt in a given area would have to be rigidly controlled, since the expert gunner has a considerable advantage in an open, flat country. Extra winter feeding at critical times would probably benefit the birds.

Species of significance to agriculture and forestry include, the Crow, Starling, Groundhog, White-Tailed Deer, Cottontail and Meadow Mouse. The American Crow is generally considered a serious pest, but recent investigations indicate that it may do about as much good as harm in farming country, by destroying enormous numbers of insects. All authorities agree that the Starling is a damaging species, but there is as yet no satisfactory way of control. The Groundhog and Cottontail are both rightly condemned, but few farmers bother to shoot them which would be a simple solution. Deer are not a serious problem in the watershed.

The Cottontail might possibly be a danger to young plantations, but it is not abundant and is not very likely to do much damage. The Meadow Mouse is discussed in a separate chapter.

Species of spectactular interest to the average citizen are rarely found in the district owing to the general lack of cover. A triangular area of about 350 square miles, between Casselman and Ventnor, is almost devoid of cover, apart from the Winchester Bog, and the few woodlots are mostly overgrazed. The outer edge of the watershed provides better cover, but no other area can compare to the Spencerville Pond and its surroundings as a wildlife sanctuary. This is the last remaining good sized area in the area for many interesting species and shows what a permanent pond resulting from a well managed conservation dam might achieve.

The plant and wildlife found in this area are described in the report. Many species, rare in this region, frequent the marshes, among them a large colony of Black Terns and an American Egret.

There is a possibility of the use of this area as a storage basin having an unfavourable effect on its value as wildlife sanctuary, at any rate for a time. It is suggested that the Authority might well consider planting a belt of trees along the outer edge of the basin.

4. IMPROVING THE FARM FOR WILDLIFE: The elimination of grazing of woodlots would be the most useful single measure in improving the wildlife environment, since this improvement depends largely on good management of farm woodlots. The forest plantations of the proposed South Nation Forest will be of value for wildlife over their whole area only in the early stages. After about twelve years coniferous forests are entirely sterile as far as most forms of wildlife are concerned, except at their edges. Good forestry practices in the farm woodlots will improve them for wildlife. Good farming practices which make a more luxuriant vegetation benefit wildlife and some conservation practices, such as strip-cropping and terracing are of particular benefit. A few field boundary hedges will help to protect crops from wind, serve as travel lanes and cover for wildlife, and harbor large numbers of songbirds which control insect pests. The most efficient wind breaks will include both trees and shrubs, selected to provide a variety of fruits for food.

Unused fence corners may be made into havens for ground-nesting species by planting a few trees and shrubs and protecting them. Food patches may be provided for the Hungarian Partridge by leaving corn or other food standing in short rows or in shocks near ground cover. Small useless areas and gullies planted with evergreens are of value to wildlife.

Many farms have at least one low spot where it would be easy to make a pond which would also be of great value. The methods of providing cover and feed plants in these ponds is described and a list of suitable aquatic plants is given in the report.

5. DETAILED STUDIES—THE MUSKRAT: The muskrat is not only the backbone of the fur industry but also can provide a definite supplementary source of income to all farmers whose land includes low marshy areas, river courses and ponds. Under proper management, a ten acre marsh should easily produce a gross annual return of $135.00–$220.00 and a net annual return of $100.00 to $175.00. This return is significant because many good or potentially good rat grounds lie in the poorer types of farm as for instance, poorly drained soils or steeply rolling land.

The muskrat industry in Southern Ontario has with few exceptions been reduced to a small fraction of its former importance through the following practices:

1. Overtrapping and reduction of the breeding population. 2. Illegal practices such as spearing, trapping out of season, cutting houses, trapping on houses. 3. The disappearance of log dams and mill dams, which formerly created many marshes. 4. Loss of marshes through the lowering of the ground water level resulting from misuse of land.

Much can be done to revive the industry by the following methods:

1. Improving the yield of the remaining rat marshes. 2. Improving marshes and swamps which have now no muskrats. 3. Making new marshes in suitable areas.

A survey was made of fifteen miles of the river from Hyndman to Charleville and is discussed in detail in the report. The life history and feeding habits of the muskrat in this area are described and the trappers catch per mile estimated. A more general survey of the whole river system was made below Crysler including peat and muck bogs. Conditions on the various parts of the system are described in detail.

Most of the South Nation River produces 30 to 50 muskrats per mile, where conditions are not unfavourable. Throughout the entire area examined, the muskrats are fat and healthy with plenty of food available, but their numbers are diminished by several factors which could be improved. Too many trappers in the same area and too long a season result in too severe trapping for the best yields. Dredging of streams ruins habitat and contributes to floods and headwater droughts harmful to muskrats. Pasturing is often so heavy that trampling of banks and grazing of water vegetation ruins about twenty-five per cent of the bank area for muskrats.

Any measures which will control floods or provide permanent summer flow will increase the number of muskrats. The building of farm ponds, and the fencing of the river from cattle, where possible, or even simply planting the banks with willows and alders, would be of benefit to the muskrat population, apart from helping preserve the water-table and prevent bank erosion. Where bogs are acquired by an authority some attention should be given to the possibilities of the muskrat as a revenue producer in the wetter sections.

The administration of trapping has lately been much improved, but closer supervision and adjustment of seasons to correspond more exactly with the spring "run" of muskrats would improve conditions still further.

On a total of 149 miles of the river examined, the annual yield is close to 3,800 muskrats. It is suggested that the whole watershed now produces 5,000 to 7,000 rats per annum. With proper management and control the yield should reach 12,000 to 20,000 rats per annum.

6. DETAILED STUDIES—THE MEADOW MOUSE: The damage done to orchards by the meadow mouse (microtus pennsylvanicus) is fairly well known. Equally serious damage can be caused by the same species to both hardwood and softwood plantations. When the mice are abundant they will eat the bark, leaves and twigs of almost any tree species, usually destroying the tree by girdling. In one area in York County where 60,000 trees were planted in 1938 and 1939, 75 per cent were destroyed by mice in the winters of 1942-43 and 1944-45. In 1947-48, 95 per cent of the trees in a 25 acres plantation in Huron County were girdled and killed in a few weeks by meadow mice. These are not the only instances in Ontario and serious losses due to a similar species of mouse have recently been experienced in Europe.

No entirely satisfactory method of preventing mouse damage has yet been found. No definite evidence of a cycle in mouse population has yet been produced. Depredations on a large scale appear to be connected with

climatic conditions producing a shortage of winter feed, rather than with peaks of population.

The southern part of the watershed was examined in 1946 and it was found that mice were extremely scarce in that area. The same was true of the northern half, examined in 1947. However, definite evidence was found that one area near Carlsbad Springs had been heavily populated in the winter of 1946-47. The plantations at present in the watershed appear to be in little danger since they are mostly on light, eroded, well-drained soils which do not provide the type of cover favourable to mice. The plantations of the proposed forest and at source areas would, however, often be on land where meadow mice might easily become a menace to the trees during the first eight or ten years. The best methods of combatting this danger would seem to be the encouragement of the natural enemies of the mouse in the neighbourhood of plantations, clean cultivation before planting, and cutting and removing grass and weeds in the plantations until the trees are about eleven years old.

Attempts at wholesale reduction of the mouse population would prove difficult and are liable to be dangerous since the mice play a large part in controlling the larch saw-fly and other injurious insects, and also provide some other wildlife with a large part of their food. Careful investigation of the population fluctuations, life history and feeding habits of mice in the area should be carried out and a survey made of all areas to be reforested to ascertain the probability of their supporting a mouse population large enough to menace the plantations. With definite knowledge of this kind available, it might be possible to forecast outbreaks of mouse damage and work out a more or less satisfactory system of control.

7. FISH: The purpose of the survey was to make a preliminary examination of the waters of the valley and classify them according to their suitability for fish and to make recommendations for possible improvements.

The shallow gradient of the South Nation drainage basin reduces the rate of flow except near some of the sources. The slow flow lessens the erosion of the streambeds and banks. The valley of the river is shallow in most places and the actual water channels in the lower reaches often wind to and fro through the valley bottoms. The degree of bank erosion on the tributaries varies, some being extremely turbid in flood, while others with shallow gradient remain comparatively clear. Much of the bed of the main river and some tributaries is limestone, either bare or covered with a thin deposit of silt. Some slower tributaries have clay bottoms.

Permanence of flow and summer temperature are two of the most important characteristics of any stream and in the rivers of Southern Ontario these two are often critical factors in fish survival. Almost all the tributaries in the southern or upper part of the watershed dry up either completely or to standing pools in summer, while there are several streams of cool and permanent summer flow in the northern or lower part. This is due to the fact that the southern streams are fed almost entirely by the run-off of the shallow soils, while in the lower part the streams mostly have their sources either in

bogs or in elevated sand plains and gravel hills. The water from the bogs is generally cold and clear, but has the characteristic tea colour. Several of these streams are already showing signs of receding, due to the partial artificial drainage of the bogs.

The mill ponds, particularly above Chesterville, do something to improve the flow in the main river, but this is almost negligible at midsummer when the mills are not operating. There are more permanent streams in the northern half of the watershed, but even these are much reduced in late summer.

The southern half of the watershed, because of its impermanent flow, has a restricted fish fauna. Pike and mudcats are everywhere abundant and sunfish, common suckers and some rock bass are found in some localities. In the lower sections of the main river pickerel, channel catfish and yellow perch are found in addition to these species. Red fin suckers and hognose suckers are also taken particularly in spring and sturgeon and garpike are occasionally taken at Plantagenet. The cool tributaries are mostly slow flowing and support mainly pike and catfish.

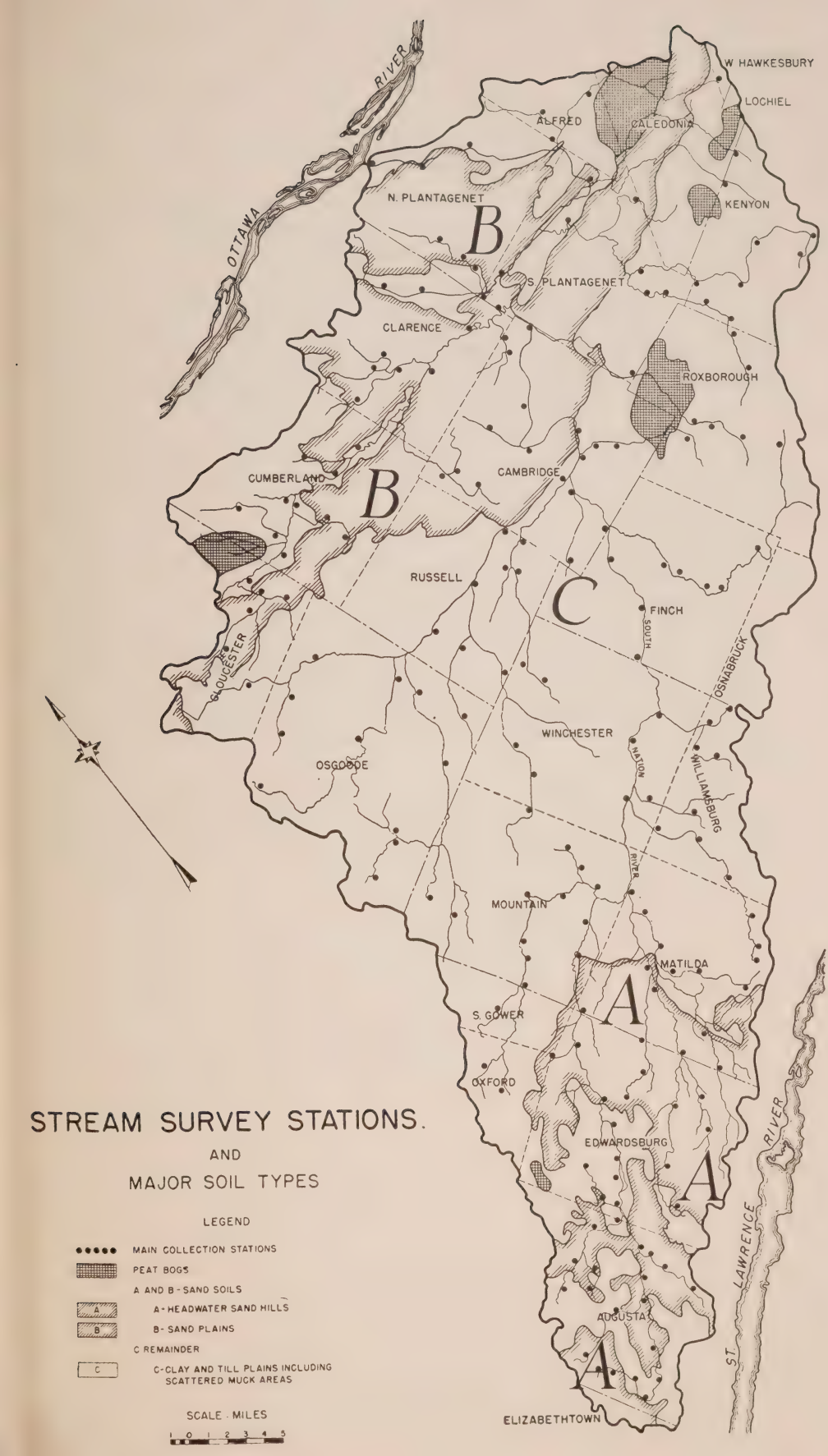
While the list of edible fishes may appear small and many of the best game fishes are absent or present in small numbers, it should be noted that the channel catfish and brown bullhead are common wherever permanent and muddy water occur and both are excellent food fishes. While no statistical summary of the catch in the Nation River is available, some indication of the interest in these species may be gained from the fact that the commercial catch alone of the two species in Prescott, Russell, Carleton and Renfrew Counties for the years 1920-22 averaged 19,000 lbs. per annum. Records for later years are not available.

Three types of pollution were noticed on the survey. Where the river dries to small standing pools, these are rapidly polluted by watering cattle and the fish often killed. The river is used as a dumping ground for all kinds of refuse and garbage in many places. This is prohibited by law, but in practice education is the recognized preventative.

Serious pollution is caused by milk wastes. The Industrial Wastes Committees of The Research Council of Ontario, sponsored in 1948 a study of waste disposal at cheese factories in Eastern Ontario. Several cheese factories in the watershed were visited, a milk condensery at Chesterville, and a casein and skim-milk powder plant at Winchester.

Quotations from the report of this committee dealing with pollution at the Winchester and Chesterville plants and typical cheese factories are given in the full report. From the results of the committees' investigations, it appears that the septic tank will provide adequate treatment for milk wastes, but where the dilution factor of the stream is not large a secondary treatment device, such as a sand filter or a field-tile bed may be necessary. The present effluents from most cheese factories are both foul smelling and often lethal to fish.

Of twelve cases of this type of pollution noted during the Conservation Survey, that from the Winchester casein plant was by far the worst, affecting


W HAWKESBURY
LOCHIEL
ALFRED
CALEDONIA
KENYON
N. PLANTAGENET
S. PLANTAGENET
CLARENCE
ROXBOROUGH
CUMBERLAND
CAMBRIDGE
RUSSELL
FINCH
SOUTH
GLOUCESTER
OSNABRUCK
WINCHESTER
OSGOODE
NATION
WILLIAMSBURG
RIVER
MOUNTAIN
MATILDA
S. GOWER
OXFORD
EDWARDSBURG
AUGUSTA
ELIZABETHTOWN
OTTAWA
RIVER
ST. LAWRENCE
RIVER
A
B
B
C
A
A
STREAM SURVEY STATIONS.
AND
MAJOR SOIL TYPES
LEGEND
MAIN COLLECTION STATIONS
PEAT BOGS
A AND B - SAND SOILS
A - HEADWATER SAND HILLS
B - SAND PLAINS
C REMAINDER
C - CLAY AND TILL PLAINS INCLUDING SCATTERED MUCK AREAS
SCALE - MILES
0 1 2 3 4 5

branches of the East Castor River and rendering the area northwest of Winchester very unsanitary, at least in summer.

Farm ponds for fish are of two kinds: cool and warm. The cool pond, with continuous inflowing water from streams or springs and a maximum temperature of 75°, is best adapted to speckled or brown trout.

Most farms have at least one low spot suitable for a pond of the warm water type. Directions for building, maintaining and stocking ponds are given in the full report. It is suggested that warm water ponds be stocked with a mixture of large mouthed bass and bluegill, at 100 bass and 1,000 bluegill per acre. The farmer who is interested in fish ponds should consult the local Fish and Wildlife supervisor, through the district office at Kemptville.

It is recommended that the introduction of fish be restricted to those parts of the river shown by the survey to be suitable for the species concerned. Even those streams which have cold water at their sources throughout the year are not at present suitable for trout except for a few spring fed streams in the vicinity of Limoges and the Larose Forest. If the banks of the cooler tributaries were planted with alder the parts suitable for trout would be extended considerably downstream.

A total of 5,500,000 pickerel fry have been introduced into various parts of the river, but except in a few places the returns have been remarkably low. Increasing the flow of water in summer will greatly increase the parts of the stream suitable for bass. The large impoundments with maintained level should provide a suitable habitat for fish such as the large mouth bass, bluegill, sunfish, and black crappie which now thrive in the weedy sections of the Rideau Canal.

Since many streams and ponds in agricultural Southern Ontario now produce little or nothing and can never be expected to produce the finer game fish, it seems reasonable to make such waters yield a valuable return of other species more suited to the changed environment.

A. H. RICHARDSON, M.A., S.M.Silv., F.E., P. Eng.
Chief Conservation Engineer.

C. E. BUSH, B.A.Sc., O.L.S., D.L.S., P.Eng.
Hydraulic Engineering.

A. S. L. BARNES, B.Sc.F.
Forestry.

W. J. P. CRESWICK, B.A.
Soils.

K. M. MAYALL, M.A., B.Sc.F.
Wildlife and Recreation.

H. F. CROWN, B.S.A.
Authorities Fieldman.

L. N. JOHNSON, B.S.A.
Authorities Fieldman.

VERSCHOYLE BLAKE
Historical Research.

PROFESSOR G. ROSS LORD, S.M., Ph.D.
University of Toronto,
Consultant in Hydraulic Engineering.

PROFESSOR F. P. IDE, M.A., Ph.D.
University of Toronto,
Consultant in Fish Research.